MARTIN COAL GASIFICATION

SITE CERTIFICATION APPLICATION

COMBINED CYCLE PROJECT

VOLUME 4

FPL

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10.0 APPENDICES

10.1 FEDERAL PERMIT APPLICATIONS OR APPROVALS

10.1.1 316 DEMONSTRATIONS

Following is a copy of the Martin Plant Cooling Pond intake monitoring report prepared for FPL in 1978 pursuant to Section 316(b) of the Federal Water Pollution Control Act of 1972, as amended (P.L. 92-500).

INTAKE MONITORING

MARTIN PLANT

COOLING POND

6 FEBRUARY - 4 APRIL 1978

For

FLORIDA POWER & LIGHT COMPANY

OCTOBER 1978

APPLIED BIOLOGY, INC.

ATLANTA, GEORGIA

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EXECUTIVE SUMMARY

Florida Power & Light Company (FPL) conducted a study to measure entrainment and impingement effects of the Martin Plant cooling pond intake structure on fish populations found in the source waters. This study was conducted to address environmental concerns raised in NPDES permit requirements.

The cooling pond was filled by pumping approximately 121 million m^3 (98,000 acre-ft) of water from the St. Lucie Canal during a period of 57.5 days. Future pumping will be on a limited basis to meet evaporative and seepage losses. Since pond filling was a one-time event, impingement and entrainment losses which occurred during this time are considered to represent the maximum impact the plant intake will have on the aquatic biota in the source waters.

IMPINGEMENT

An average of 4380 fish weighing a total of 29.4 kg (64.8 lbs) were collected per 24-hr impingement sample. Sunfishes and shad, which are abundant fish species in Lake Okeechobee, composed over 96 percent of the fishes found. The majority of these were juveniles. No rare or endangered fish species were impinged during the survey.

The impingement rate calculated by weight averaged less than 0.3 percent of the average monthly commercial catch from Lake Okeechobee. Considering the high productivity of Lake Okeechobee and the abundance of the sunfish and shad in the source water, the impact of impingement on Lake Okeechobee fish populations was considered negligible.

ENTRAINMENT

Larval fish densities found during entrainment sampling averaged 1.98 individuals per cubic meter. Over 90 percent of the larval fishes found were shad, which are highly prolific and abundant in the source waters.

Only two fish eggs were found during the entire 57.5-day study. The relatively low number of eggs found, compared to the number of larvae, suggests that spawning occurred in Lake Okeechobee rather than in the immediate vicinity of the cooling pond intake. The larvae were then transported from the lake via the St. Lucie Canal.

Stress on fishes entrained by the Martin Plant cooling pond intake pumps was considerably less than at sites where passage is through cooling condensers and associated with an abrupt rise in water temperature. Entrainment mortality studies conducted at other sites indicate that many of the fish larvae which may have been entrained at the Martin Plant pond intake probably survived passage through the intake pumps and into the pond. These fish are expected to establish populations there.

The impact on Lake Okeechobee fish populations due to entrainment of eggs and larvae is considered to be negligible considering the high productivity of Lake Okeechobee and the abundance of the same species of fish in both the source waters and the entrainment samples.

CONCLUSION

The impact of fish impingement and entrainment on fish populations in the source waters as a result of the one-time filling of the Martin Plant cooling pond was negligible. Future impacts will be limited to when pumping is required to compensate for evaporative and seepage loss of water from the pond.

INTRODUCTION

BACKGROUND

As part of negotiations with the Environmental Protection Agency (EPA) over the required National Pollutant Discharge Elimination System (NPDES) Permit for the Martin Plant, Florida Power & Light Company (FPL) conducted a study to measure entrainment and impingement effects of the cooling pond intake structure on fish populations in the source waters. The 1972 amendments to the Federal Water Pollution Control Act (P.L. 92-500) require in Section 316(b) that the location, design, construction and capacity of cooling water intake structures reflect the best available technology for minimizing adverse environmental impact. As interpreted by the EPA (1977), adverse environmental impacts occur whenever there is impingement or entrainment damage resulting from operation of a specific cooling water intake structure. The critical question is the magnitude of any adverse impact.

The goal of a 316(b) intake monitoring study is to obtain sufficient information to determine whether the technology selected by the company is the best available to minimize adverse environmental impact. The following study was designed to address this goal. The 316(b) study program prescribed a concentrated biological monitoring effort during the initial pond filling, when all intake pumps were to be in operation continually for an extended period of time. The proposed study program was accepted by the EPA in January 1978 and made part of the draft NPDES Permit at that time.

Initial filling of the Martin cooling pond was contingent upon permission of the South Florida Water Management District (SFWMD). This permission was granted on 3 February 1978 at a meeting between FPL and the SFWMD and the pond was filled during the period 6 February through 4 April 1978. The 316(b) study program was conducted during this time and the results obtained are herein reported.

SITE DESCRIPTION

The FPL Martin Plant Site is located about 6 miles west of Indiantown, Martin County, Florida, and about 2-1/2 miles east of Lake Okeechobee (Figure 1). The facility consists of two 850-MW steam-powered electric generating units, presently under construction, located on the northeast side of a pond. The pond was built to hold water for cooling the generating unit condensers, and contains a maximum of about 117 million m^3 (95,000 acre-ft) of water with a surface area of about 2830 hectares (7,000 acres).

The cooling pond was created by construction of an embankment and subsequent flooding of the area. The embankment varies from a maximum height above the natural ground surface of 9 m (30 ft) along the west side near the Florida East Coast Railroad to a minimum height of 5.5 m (18 ft) on the northeast side of the pond. A dike (Figure 1) was constructed within the pond to divert heated water away from the plant intake and allow maximum cooling before the water re-enters the plant.

Following completion of the embankment and dikes, and the pumping station and spillway at the south end of the pond (Figure 1) the pond was filled by pumping water from Lake Okeechobee through the St. Lucie Canal and pond intake canal. The intake canal (Figure 2) is

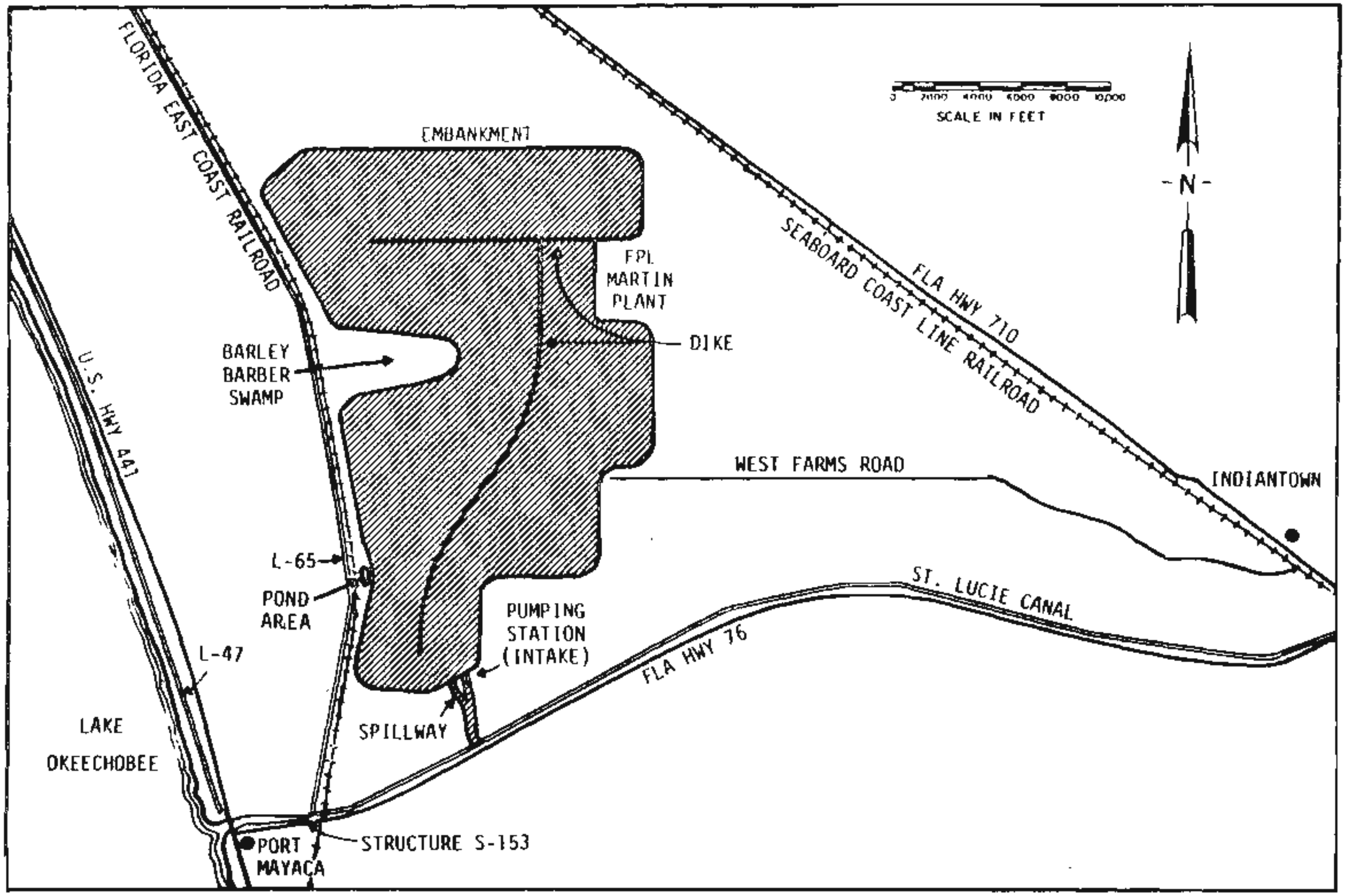

Figure 1. Martin Plant cooling pond and surrounding area.

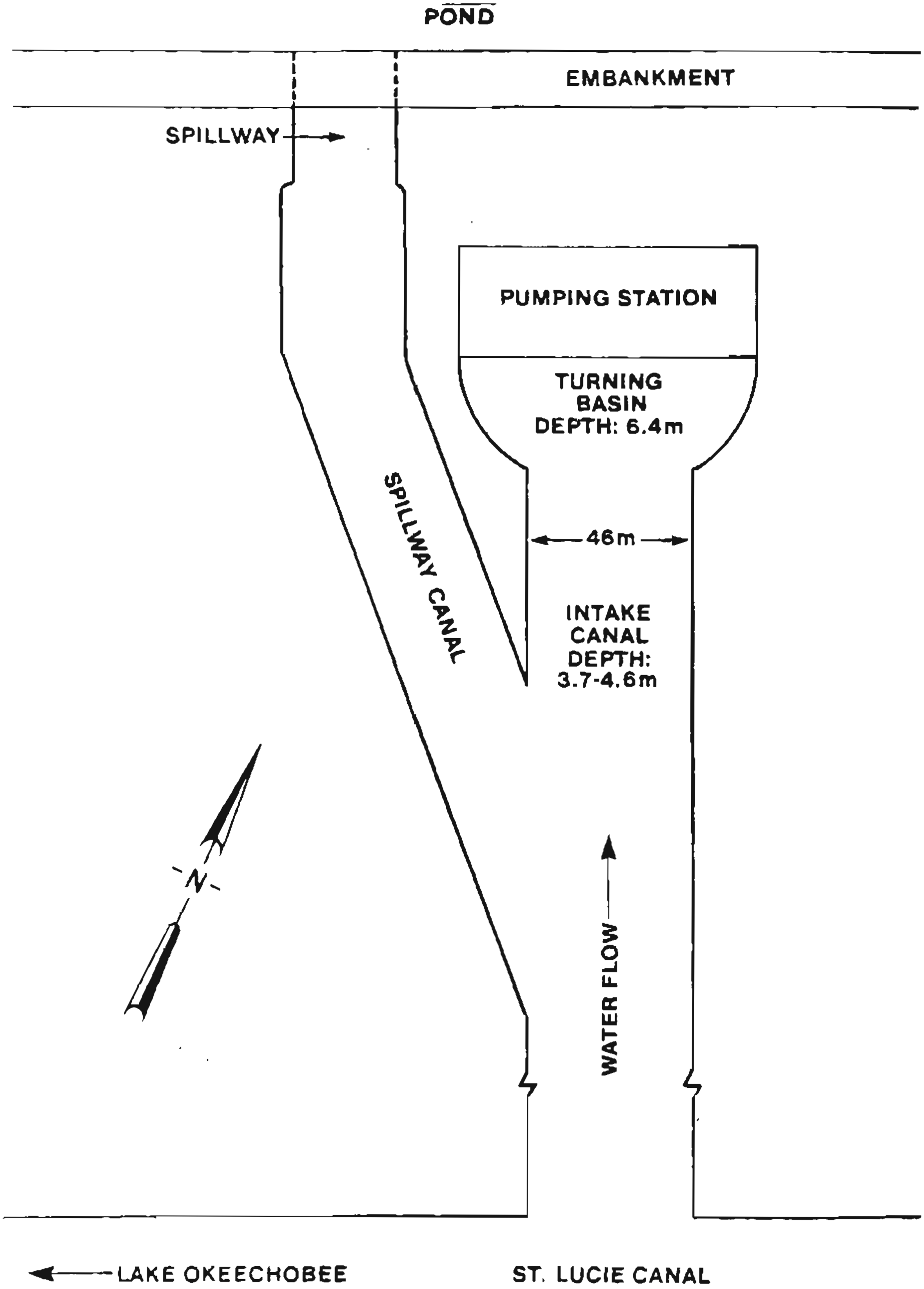

Figure 2. Diagrammatic view of the intake area, Martin Plant cooling pond.

about 915 m (3000 ft) long, 46 m (150 ft) wide and 3.7 to 4.6 m (12 to 15 ft) deep. A 6.4-m (21-ft) deep turning basin is located at the end of the intake canal directly in front of the pumping station. The pumping station has eight sets of traveling screens located just upstream of the pumps. The traveling screens, which limit the size of the debris passing through the pumps, have a mesh size of 13 mm^2 (0.5 in^2). The four pumps at the station each have a rated capacity of 379 m^3/min (100,000 gpm). These pumps create a water velocity of 15 cm/sec (0.5 fps) directly in front of the screens.

During the life of the project the water surface elevation will fluctuate between Elevation 31 (31 ft above sea level) and Elevation 37, depending on the availability of water and the mode of pond operation directed by the South Florida Water Management District. During this operation the pond will lose water by natural and forced evaporation and water will be added by rainfall. Seepage will occur from the pond and all seepage water is expected to ultimately return to the St. Lucie Canal. Water will be added to the pond at various times by pumping from the St. Lucie Canal.

IMPINGEMENT

METHODS AND MATERIALS

Impingement samples were taken twice weekly[a] from 6 February through 30 March 1978. Each 24-hr sampling period was divided into two consecutive 12-hr periods: 0700-1900 and 1900-0700 hrs. Data from each time period were analyzed by one-way analysis of variance to determine if there was any diel (day versus night) variation in concentrations of fishes impinged.

Fishes washed off the traveling screens were collected in a 6-m^3 (8-yd^3) basket of 9.5-mm^2 (0.4-in^2) mesh. Specimens were identified to species, counted, measured to the nearest millimeter standard length, and weighed to the nearest gram. Individuals within each species were separated and recorded by 4-cm (1.6-in) size classes. Taxonomic nomenclature was in accordance with Bailey et al. (1970).

Sampling time, as a percentage of pump operation time, was determined by the formula:

$$\text{Sampling time (\%)} = \frac{\text{Sampling time (hrs)}}{\text{Pumping time (hrs)}} \times 100$$

Pumping time was 1380 hrs, an approximation based on 57.5 days pumping from 6 February through 4 April times 24 hrs per day.

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[a]Once weekly during 5-11 March.

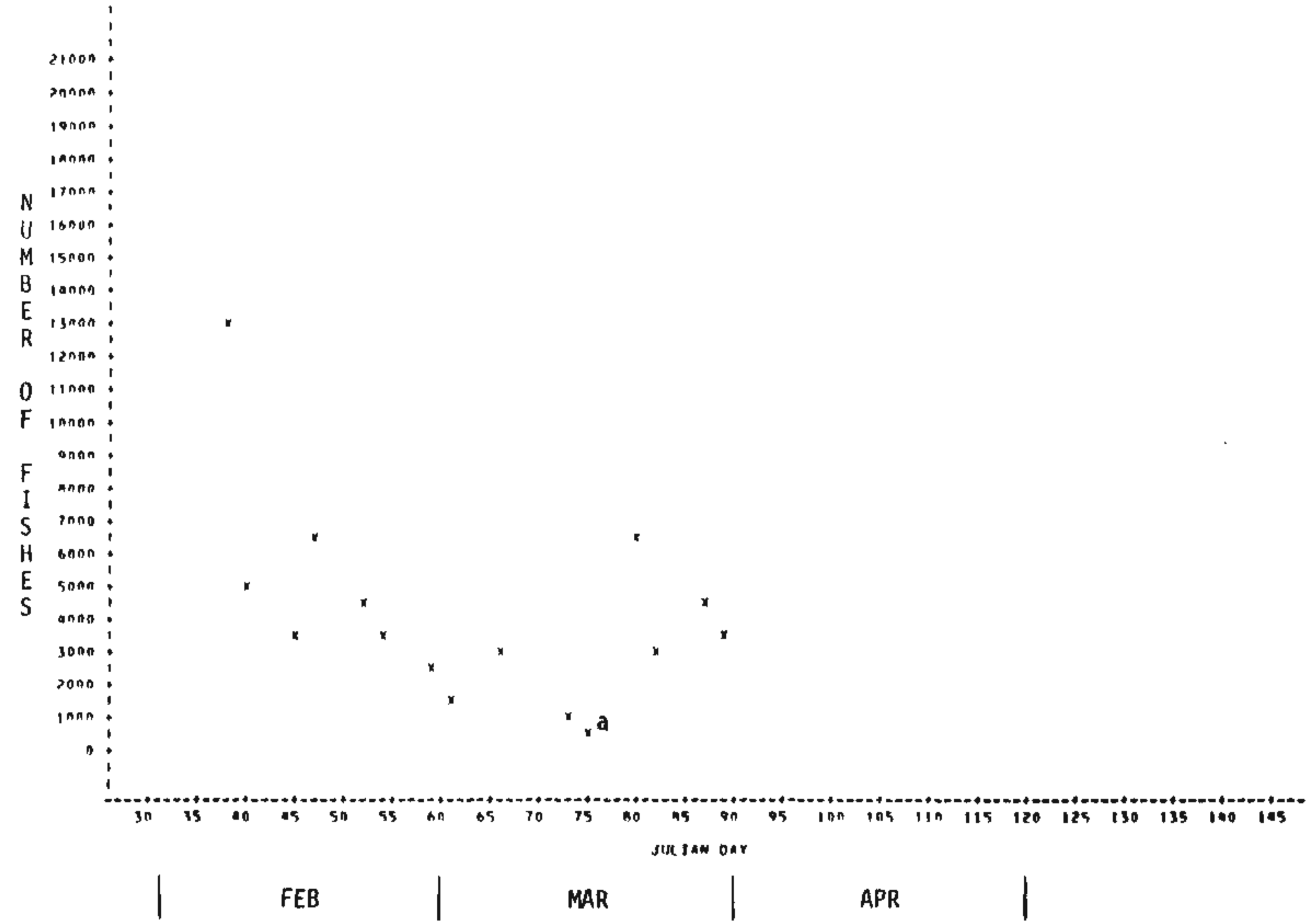
RESULTS AND DISCUSSION

Twenty-nine 12-hr samples were collected and analyzed during the two study months. Sampling time was 25.2 percent of pump operation time. The number of fishes collected per 24-hr sampling period ranged from 1141 to 13,036 individuals (Figure 3) with an average of 4380 fishes. Biomass per 24-hr sampling period ranged from 12 to 52.5 kg (Figure 4), with an average biomass of 29.4 kg. The largest number of individuals was collected during the first sampling period (Figure 3). This initial impingement sample consisted of 13,036 individuals collected during a 24-hr period. Subsequent samples contained 6662 or fewer individuals during each 24-hr collection period. The comparatively high initial impingement sample, followed by the collection of fewer fishes in subsequent samples, may have been coincidental or may have represented a "thinning out" of fishes concentrated in the intake canal prior to pumping. A concentration of fishes could have built up in the intake canal prior to pumping because of the large amount of aquatic vegetation along shore which, in turn, would have provided better fish habitat than was found in the St. Lucie Canal.

The number and biomass of fishes collected during individual day and night periods are plotted in Appendix Figures 1 through 4. There were no significant (α=0.05) differences between day and night sampling periods for either the number of individuals or biomass of fishes in the samples (Appendix Tables 16 and 17).

FIGURE 3

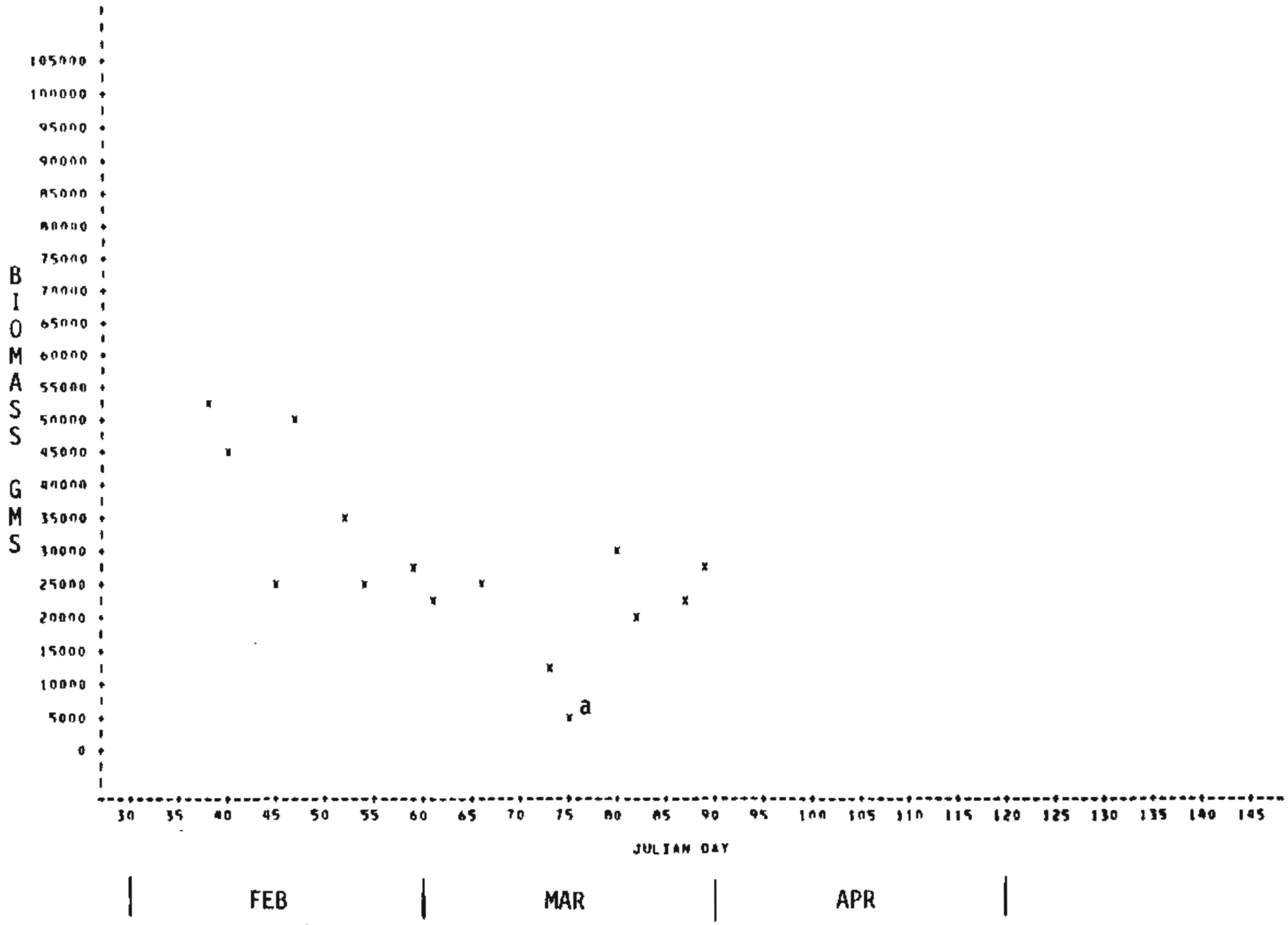
NUMBER OF FISHES COLLECTED PER 24-HR IMPINGEMENT SAMPLING PERIOD
MARTIN PLANT COOLING POND
6 FEBRUARY - 30 MARCH 1978



[a]12-hr. sample

FIGURE 4

BIOMASS OF FISHES COLLECTED PER 24-HR IMPINGEMENT SAMPLING PERIOD
MARTIN PLANT COOLING POND
6 FEBRUARY - 30 MARCH 1978



[a]12-hr. sample

Total impingement while the cooling pond was filling was calculated as 246,306 individuals and 1689 kg (3716 lbs), or an average of about 880 kg (1940 lbs) per month. The impact of this impingement on the source water is insignificant because of the high productivity of Lake Okeechobee as shown in the commercial landing records. The average commercial landing from Lake Okeechobee for the period 15 October 1976 through January 1978 was about 273,000 kg (602,000 lbs) per month.[a] Impingement at the Martin Plant cooling pond intake was only 0.3 percent of the average monthly commercial catch. Because filling the cooling pond was a one-time event and subsequent pumping will be on a limited basis for make-up purposes only, future impact on fish populations resulting from impingement at the pond intake is expected to be insignificant.

Taxa of Impinged Fishes

Twenty-two species of fishes in 12 families were found during impingement sampling (Table 1). The number of individuals, length ranges and weight for each species collected during the two diel time periods are tabulated in Appendix Tables 1 through 15. Total number, weight and percentage composition by species are listed in Table 2, and size distributions are listed in Table 3.

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[a]Lake Okeechobee commercial landings data have not yet been published. These data were provided through the courtesy of the Florida Game and Fresh Water Fish Commission.

TABLE 1

COMMON AND SCIENTIFIC NAMES OF FISHES
COLLECTED AT THE MARTIN PLANT
FEBRUARY-APRIL 1978

Clupeidae-herrings	
Gizzard shad	*Dorosoma cepedianum*
Threadfin shad	*D. petenense*
Engraulidae-anchovies	
Bay anchovy	*Anchoa mitchilli*
Cyprinidae-minnows	
Golden shiner	*Notemigonus crysoleucas*
Catostomidae-suckers	
Lake chubsucker	*Erimyzon sucetta*
Ictaluridae-freshwater catfishes	
White catfish	*Ictalurus catus*
Yellow bullhead	*I. natalis*
Channel catfish	*I. punctatus*
Tadpole madtom	*Noturus gyrinus*
Clariidae-airbreathing catfishes	
Walking catfish	*Clarias batrachus*
Belonidae-needlefishes	
Atlantic needlefish	*Strongylura marina*
Cyprinodontidae-killifishes	
Seminole killifish	*Fundulus seminolis*
Atherinidae-silversides	
Tidewater silverside	*Menidia beryllina*
Syngnathidae-pipefishes and seahorses	
Opossum pipefish	*Oostethus lineatus*
Centrarchidae-sunfishes	
Bluespotted sunfish	*Enneacanthus gloriosus*
Warmouth	*Lepomis gulosus*
Bluegill	*L. macrochirus*
Redear sunfish	*L. microlophus*
Largemouth bass	*Micropterus salmoides*
Black crappie	*Pomoxis nigromaculatus*

TABLE 1
(continued)
COMMON AND SCIENTIFIC NAMES OF FISHES
COLLECTED AT THE MARTIN PLANT
FEBRUARY-APRIL 1978

Percidae-perches	
Swamp darter	*Etheostoma fusiforme*[a]
Gobiidae-gobies	
Naked goby	*Gobiosoma bosci*
Clown goby	*Microgobius gulosus*

[a]Tentative identification of larvae; collected during entrainment sampling only.

TABLE 2

NUMBER, BIOMASS, AND PERCENTAGE COMPOSITION OF FISHES COLLECTED
DURING 24-HOUR IMPINGEMENT SAMPLES AT THE MARTIN PLANT
FEBRUARY - MARCH 1978

SPECIES	DAY SAMPLES NO. *	DAY SAMPLES WT. **	% COMPOSITION NO.	% COMPOSITION WT.	NIGHT SAMPLES NO.	NIGHT SAMPLES WT.	% COMPOSITION NO.	% COMPOSITION WT.	OVERALL NO.	OVERALL WT.	% COMPOSITION NO.	% COMPOSITION WT.
GIZZARD SHAD	911	57103	3.0	25.7	1128	62710	3.6	30.9	2039	119893	3.3	28.2
THREADFIN SHAD	6952	22447	22.6	10.1	10691	29709	34.1	14.6	17643	52156	28.4	12.3
BAY ANCHOVY	233	1006	0.8	0.5	426	1881	1.4	0.9	659	2887	1.1	0.7
GOLDEN SHINER	1	178	0.0	0.1	3	389	0.0	0.2	4	567	0.0	0.1
LAKE CHUBSUCKER	2	271	0.0	0.1	2	472	0.0	0.2	4	743	0.0	0.2
WHITE CATFISH	32	3119	0.1	1.4	35	2462	0.1	1.2	67	5581	0.1	1.3
YELLOW BULLHEAD	1	10	0.0	0.0	.	.	.	.	1	10	0.0	0.0
CHANNEL CATFISH	93	1500	0.3	0.7	65	1087	0.2	0.5	158	2587	0.3	0.6
TADPOLE MADTOM	63	329	0.2	0.1	37	222	0.1	0.1	100	551	0.2	0.1
WALKING CATFISH	2	179	0.0	0.1	.	.	.	.	2	179	0.0	0.0
ATLANTIC NEEDLEFISH	31	377	0.1	0.2	44	356	0.1	0.2	75	733	0.1	0.2
SEMINOLE KILLIFISH	14	174	0.0	0.1	15	228	0.0	0.1	29	402	0.0	0.1
TIDEWATER SILVERSIDE	36	56	0.1	0.0	47	56	0.2	0.0	83	112	0.1	0.0
PIPEFISH	2	4	0.0	0.0	2	5	0.0	0.0	4	9	0.0	0.0
BLUESPOTTED SUNFISH	2	5	0.0	0.0	5	11	0.0	0.0	7	16	0.0	0.0
WARMOUTH	7	16	0.0	0.0	3	7	0.0	0.0	10	23	0.0	0.0
BLUEGILL	19314	71852	62.8	32.3	16675	58413	53.3	28.8	35989	130265	58.0	30.6
REDEAR SUNFISH	672	3898	2.2	1.8	634	3620	2.0	1.8	1306	7518	2.1	1.8
LARGEMOUTH BASS	1	30	0.0	0.0	1	26	0.0	0.0	2	56	0.0	0.0
BLACK CRAPPIE	2342	59849	7.6	26.9	1443	41340	4.6	20.4	3785	101189	6.1	23.8
NAKED GOBY	1	2	0.0	0.0	7	8	0.0	0.0	8	10	0.0	0.0
CLOWN GOBY	47	97	0.2	0.0	47	94	0.2	0.0	94	191	0.2	0.0

* NUMBER OF INDIVIDUALS.

** WEIGHT IN GRAMS.

TABLE 3

PERCENTAGE COMPOSITION OF IMPINGED FISH
NUMBER AND BIOMASS IN 4 CM. SIZE CLASSES
MARTIN PLANT
FEBRUARY-MARCH 1978

TAXON	SIZE CLASS	NUMBER	% COMPOSITION	WEIGHT	% COMPOSITION
ATLANTIC NEEDLEFISH	8	2	2.7	8	1.1
ATLANTIC NEEDLEFISH	12	12	16.0	74	10.0
ATLANTIC NEEDLEFISH	16	18	24.0	91	12.5
ATLANTIC NEEDLEFISH	20	34	45.3	203	27.6
ATLANTIC NEEDLEFISH	24	7	9.3	73	10.0
ATLANTIC NEEDLEFISH	28	2	2.7	284	38.7
BAY ANCHOVY	8	651	98.8	2846	98.6
BAY ANCHOVY	12	8	1.2	41	1.4
BLACK CRAPPIE	8	417	11.0	4639	4.6
BLACK CRAPPIE	12	3127	82.6	69810	69.0
BLACK CRAPPIE	16	164	4.3	10571	10.4
BLACK CRAPPIE	20	53	1.4	9069	9.0
BLACK CRAPPIE	24	23	0.6	6658	6.6
BLACK CRAPPIE	28	1	0.0	442	0.4
BLUEGILL	4	6050	16.8	8939	6.9
BLUEGILL	8	29829	82.9	113010	86.8
BLUEGILL	12	63	0.2	1935	1.5
BLUEGILL	16	23	0.1	2849	2.2
BLUEGILL	20	24	0.1	3532	2.7
BLUESPOTTED SUNFISH	4	7	100.0	15	100.0

TABLE 3
(CONTINUED)
PERCENTAGE COMPOSITION OF IMPINGED FISH
NUMBER AND BIOMASS IN 4 CM. SIZE CLASSES
MARTIN PLANT
FEBRUARY-MARCH 1978

TAXON	SIZE CLASS	NUMBER	% COMPOSITION	WEIGHT	% COMPOSITION
CHANNEL CATFISH	8	62	39.2	310	12.0
CHANNEL CATFISH	12	67	42.4	926	35.8
CHANNEL CATFISH	16	24	15.2	897	34.7
CHANNEL CATFISH	20	4	2.5	359	13.9
CHANNEL CATFISH	24	1	0.6	95	3.7
CLOWN GOBY	4	2	2.1	3	1.5
CLOWN GOBY	8	92	97.9	188	98.5
GIZZARD SHAD	8	16	0.8	108	0.1
GIZZARD SHAD	12	1259	61.7	20928	17.5
GIZZARD SHAD	16	430	21.1	13107	10.9
GIZZARD SHAD	20	29	1.4	2647	2.2
GIZZARD SHAD	24	35	1.7	6329	5.3
GIZZARD SHAD	28	217	10.6	58503	48.8
GIZZARD SHAD	29	53	2.6	18271	15.2
GOLDEN SHINER	12	2	50.0	25	4.4
GOLDEN SHINER	24	1	25.0	178	31.4
GOLDEN SHINER	28	1	25.0	364	64.2
LAKE CHUBSUCKER	8	1	25.0	10	1.3
LAKE CHUBSUCKER	24	3	75.0	733	98.7

TABLE 3
(CONTINUED)
PERCENTAGE COMPOSITION OF IMPINGED FISH
NUMBER AND BIOMASS IN 4 CM. SIZE CLASSES
MARTIN PLANT
FEBRUARY-MARCH 1978

TAXON	SIZE CLASS	NUMBER	% COMPOSITION	WEIGHT	% COMPOSITION
LARGEMOUTH BASS	12	2	100.0	56	100.0
NAKED GOBY	4	7	87.5	8	81.8
NAKED GOBY	8	1	12.5	2	18.2
PIPEFISH	16	4	100.0	9	100.0
REDEAR SUNFISH	4	53	4.1	80	1.1
REDEAR SUNFISH	8	1203	92.1	5558	73.9
REDEAR SUNFISH	12	44	3.4	1011	13.5
REDEAR SUNFISH	16	4	0.3	437	5.8
REDEAR SUNFISH	20	2	0.2	432	5.7
SEMINOLE KILLIFISH	8	1	3.4	15	3.7
SEMINOLE KILLIFISH	12	28	96.6	387	96.3
TADPOLE MADTOM	8	99	99.0	532	98.3
TADPOLE MADTOM	12	1	1.0	9	1.7
THREADFIN SHAD	4	210	1.2	287	0.5
THREADFIN SHAD	8	16727	93.8	41615	79.8
THREADFIN SHAD	12	700	3.9	10166	19.5
THREADFIN SHAD	16	6	0.0	88	0.2

TABLE 3
(CONTINUED)
PERCENTAGE COMPOSITION OF IMPINGED FISH
NUMBER AND BIOMASS IN 4 CM. SIZE CLASSES
MARTIN PLANT
FEBRUARY-MARCH 1978

TAXON	SIZE CLASS	NUMBER	% COMPOSITION	WEIGHT	% COMPOSITION
TIDEWATER SILVERSIDE	4	16	19.3	16	14.5
TIDEWATER SILVERSIDE	8	67	80.7	95	85.5
WALKING CATFISH	20	1	50.0	66	36.9
WALKING CATFISH	24	1	50.0	113	63.1
WARMOUTH	4	4	40.0	5	21.7
WARMOUTH	8	6	60.0	18	78.3
WHITE CATFISH	8	5	7.5	30	0.5
WHITE CATFISH	12	12	17.9	260	4.7
WHITE CATFISH	16	21	31.3	1390	24.9
WHITE CATFISH	20	21	31.3	2392	42.9
WHITE CATFISH	24	5	7.5	523	9.4
WHITE CATFISH	28	3	4.5	986	17.7
YELLOW BULLHEAD	12	1	100.0	10	100.0

Sunfishes

Six species of sunfishes were collected during impingement sampling. This family made up 66.2 percent of the total number of fishes collected and 56.2 percent of the biomass. Over half (58 percent) of all fishes collected were bluegill (Table 2) and most of these were juveniles ($\leq$80 mm SL; Table 3). Black crappie accounted for 6.1 percent of the number of fishes and 23.8 percent of the biomass, and redear sunfish made up 2.1 percent of the number of fishes and 1.8 percent of the biomass. Most of the black crappie and redear sunfish were also juveniles (Table 3). The three other species of sunfishes were each represented by 10 or fewer individuals. Only two largemouth bass were found.

Bluegill, black crappie and redear sunfish are abundant species in Lake Okeechobee and are important components of the sport catch as well as the recently (1976) initiated commercial harvest in the lake. During the 15.5 months from 15 October 1976 through 30 January 1978, the combined commercial landings of these three species averaged about 153,000 kg (336,000 lbs) per month. These figures are included as an indication of the abundance of sunfishes in the area. Although a calculated average 495 kg (1090 lbs) of sunfishes were impinged per month, this occurred for only two months while the cooling pond was being filled. The impact of impingement on sunfish populations in the source waters is not considered to be significant.

Shad

Threadfin shad accounted for 28.4 percent of the number of fishes collected and 12.3 percent of the biomass; gizzard shad for 3.3 percent of the number and 28.2 percent of the biomass (Table 2). These species are not considered to be of sport, food or commercial importance, although juvenile gizzard shad and all life history stages of threadfin shad are important forage items in the diets of black crappie, largemouth bass and other predatory species.

Both shad species are abundant in Lake Okeechobee. An average of about 44,000 kg (97,000 lbs) of shad were taken per month in the commercial harvest from October 1976 through January 1978. These were taken incidental to the target species and were generally buried (land-fill) or used as crab bait. The loss due to impingement of a calculated average 355 kg (780 lbs) of shad per month during filling of the cooling pond is not considered to have had a significant impact on shad populations in the source waters.

Other Fishes

Fishes other than sunfish and shad accounted for only 2.1 percent of the total number of fishes collected and less than 4 percent of the biomass (Table 2). Of this group, catfishes were the only species of sport or commercial importance. A total of 226 catfishes (white catfish, channel catfish and yellow bullhead) were found during impingement sampling. Catfish biomass was calculated to be an average of 17 kg

(37 lbs) impinged during each of the two months the cooling pond was being filled. As indicated by the commercial catfish landings of about 54,000 kg (118,000 lbs) average per month, populations in the source waters are high, and the impact of impingement during filling of the cooling pond was not considered to be significant.

The walking catfish was the only exotic (introduced) species found during impingement sampling. Two individuals were collected.

Rare or Endangered Species

No rare or endangered species were encountered during sampling.

ENTRAINMENT

METHODS AND MATERIALS

Entrainment samples were taken twice weekly from 7 February through 4 April at four locations: Station 1) mid-channel in the St. Lucie Canal upstream from the intake canal, 2) near-shore in the St. Lucie Canal upstream from the intake canal, 3) mid-channel in the intake canal, and 4) near-shore in the intake canal.

Samples were collected at discrete near-surface and near-bottom depths during both day and night periods on each sampling date at each of the four stations. An ichthyoplankton net of 0.5-m mouth diameter and 505μ mesh was towed for 5 min to obtain each sample. A digital read-out flowmeter (General Oceanics Model 2030) was suspended in the mouth of the net to enable calculation of the volume of water passed through the net during each tow.

Each of the samples was preserved in 5 percent formalin and taken to the laboratory for microscopic and statistical analysis. Fish eggs were counted and measured to the nearest 0.1-mm diameter. Larval fishes were identified to the lowest taxonomic classification practical, counted and measured to the nearest 0.1-mm total length. In the tables, the category "herrings" includes members of the genus *Dorosoma* (thread-fin and gizzard shad) and the category "sunfishes" includes members of the genus *Lepomis* (bluegill, redear sunfish, etc.). The category "perches" includes fishes which have been tentatively identified as swamp darters.

Statistical analyses were performed by procedures of the Statistical Analysis System (SAS; Barr et al., 1976). The General Linear Model (GLM) Procedure was employed to give the regression approach to analysis of variance (ANOVA) using class variables to determine overall station, diel period, depth and interaction effects. Examples of these variables, and the model used, are shown in Table 4 . Due to unequal error variance and the skewed distribution of the data, log transformations were made on the dependent variable (larval densities) before means and ANOVA were calculated.

RESULTS AND DISCUSSION

Two hundred fifty-six samples were collected and analyzed during the two study months. The mean densities (numbers/m^3) of larval fishes and fish eggs collected by date, station, depth and diel period for each category (species or other taxa) are presented in Appendix Table 18. This table also includes the size ranges of the different fishes found and the number of individuals collected. The total larval fish and egg densities by date, station, diel period and depth are included in Appendix Table 19.

TABLE 4

EXAMPLES OF THE VARIABLES, CLASS VARIABLES AND MODELS USED BY THE GENERAL LINEAR MODELS PROCEDURE

VARIABLES			
(Y_1)	($X_{1,2}$)	($X_{3,4}$)	(X_0)
Density	Station	Diel Period	Intercept
Y_{i1}	1	Day	1
Y_{i1}	1	Night	1
Y_{i1}	2	Day	1
Y_{i1}	2	Night	1

CLASS VARIABLES			
Station		Diel Period	
1	2	Day	Night
X_{i1}	X_{i2}	X_{i3}	X_{i4}
1	0	1	0
1	0	0	1
0	1	1	0
0	1	0	1

MODEL

For station and period effects:

$$Y_i = B_0X_0 + B_1X_{i1} + B_2X_{i2} + B_3X_{i3} + B_yX_{i4} + \Sigma_i$$

Fish Larvae

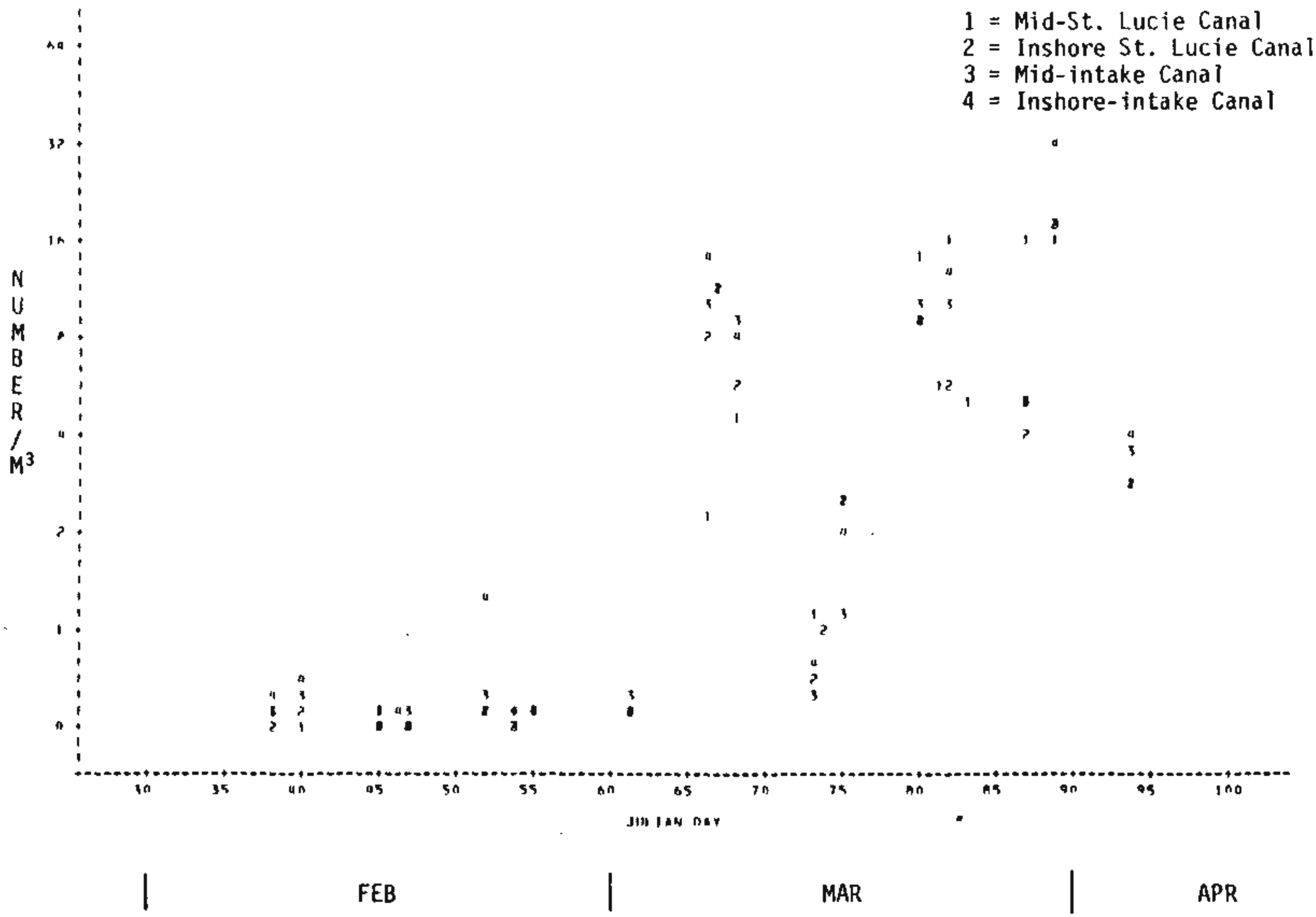
The mean density of larvae collected at each station during each sampling date ranged from less than one individual per m^3 during the initial sampling to 34 per m^3 near the end of March (Figure 5). The mean density for all stations on all dates was 1.98 larvae per m^3. Larval fish densities by depth and diel period for each station are presented in Table 5.

Over 90 percent of the larval fishes found in both the St. Lucie Canal and the intake canal were herring of the genus *Dorosoma* (Table 6). Although not specifically differentiated, both threadfin and gizzard shad were probably represented. These two species have high fecundities (eggs per female) and, as previously mentioned, are abundant in Lake Okeechobee.

Black crappie and tidewater silverside were the only other species besides herring that composed over 1 percent of the total fishes collected during the entrainment study. Black crappie, as discussed previously, is an abundant sport and commercial species. Black crappie made up 1.4 percent of the samples in the St. Lucie Canal and 6.9 percent in the intake. This difference in percentage composition of black crappie between the St. Lucie Canal and the intake canal is not considered significant. The tidewater silverside is a small ($\leq$80 mm SL) forage species that made up 1.4 percent of the sample in the St. Lucie Canal and 1.2 percent in the intake (Table 6).

FIGURE 5

MEAN[a] LARVAL FISH DENSITIES FOUND DURING ENTRAINMENT SAMPLING
MARTIN PLANT COOLING POND
7 FEBRUARY - 4 APRIL 1978



[a]The mean of day, night, surface and bottom samples at each station.

TABLE 5

MEAN DENSITIES OF FISH LARVAE AND EGGS COLLECTED DURING ENTRAINMENT SAMPLING
BY STATION, PERIOD AND DEPTH
FEBRUARY - APRIL 1978
MARTIN PLANT

STATION	PERIOD **	DEPTH *	LARVAE SIZE RANGE MIN.	LARVAE SIZE RANGE MAX.	LARVAE # MEAN NO./M3	EGGS SIZE RANGE MIN.	EGGS SIZE RANGE MAX.	EGGS # MEAN NO./M3
1	D	B	3.7	13.6	1.462	.	.	0.000
1	D	S	3.4	18.1	1.981	.	.	0.000
2	D	B	3.4	13.2	1.886	.	.	0.000
2	D	S	3.9	13.8	1.467	.	.	0.000
3	D	B	3.6	18.4	1.160	.	.	0.000
3	D	S	3.9	12.0	2.114	.	.	0.000
4	D	B	3.6	16.8	1.712	0.9	0.9	0.014
4	D	S	3.6	15.6	2.651	.	.	0.000
1	N	B	3.6	19.8	2.306	.	.	0.000
1	N	S	3.4	22.4	2.091	.	.	0.000
2	N	B	3.4	33.6	1.730	.	.	0.000
2	N	S	3.4	29.0	1.732	.	.	0.000
3	N	B	3.9	13.0	2.483	.	.	0.000
3	N	S	3.2	28.6	2.234	1.1	1.1	0.014
4	N	B	3.3	16.5	2.778	.	.	0.000
4	N	S	3.7	23.0	2.753	.	.	0.000

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

**
D=DAY; N=NIGHT.

#
GEOMETRIC MEAN.

TABLE 6

MEAN DENSITY AND PERCENTAGE COMPOSITION OF FISH LARVAE
COLLECTED DURING ENTRAINMENT SAMPLING
MARTIN PLANT COOLING POND
6 FEBRUARY - 30 MARCH 1978

CATEGORY	ST. LUCIE CANAL MEAN DENSITY (NO./M3)	ST. LUCIE CANAL PERCENTAGE COMPOSITION	INTAKE CANAL MEAN DENSITY (NO./M3)	INTAKE CANAL PERCENTAGE COMPOSITION
HERRINGS	4.216	97.0	5.007	91.6
SUCKERS	.	0.0	0.000	0.0
GOLDEN SHINER	.	0.0	0.005	0.1
SHINERS	.	0.0	0.000	0.0
ATLANTIC NEEDLEFISH	0.001	0.0	.	0.0
TIDEWATER SILVERSIDE	0.062	1.4	0.066	1.2
BLACK CRAPPIE	0.060	1.4	0.379	6.9
SUNFISHES	0.001	0.0	0.001	0.0
PERCHES	0.004	0.1	0.004	0.1
NAKED GOBY	0.000	0.0	0.000	0.0
CLOWN GOBY	0.003	0.1	0.004	0.1
UNIDENTIFIED LARVAE	.	0.0	0.000	0.0

The larval fish densities found at each station during the day and night at surface and bottom depths are plotted in Appendix Figures 5 through 8. There were no significant (α=0.01) differences in larval densities between stations or depths (Table 7); however, there was a difference between diel periods. Larval densities at night were significantly (α=0.01) higher than those found during the day. For more larvae to be found during the night than during the day is not unusual, and has been reported from the Sanford and Palatka Plants (ABI, 1976a; 1976b), where the aquatic habitats are similar to those at Martin. Greater larval densities during the night at the Martin Plant cooling pond intake are attributed to increased larval fish movement out of Lake Okeechobee at that time.

Fish Eggs

Only two fish eggs were found during the entire study, which accounts for the very low mean densities ($\leq$0.001 per m^3) recorded in Table 5. The relatively high numbers of larvae found, compared to the number of eggs, suggests that spawning occurred in Lake Okeechobee rather than in the immediate vicinity of the intake, and the larvae were transported from the lake via the St. Lucie Canal. Spawning habitat is very limited in the St. Lucie Canal and finding few fish eggs at the cooling pond intake was to be expected.

TABLE 7

ANALYSIS OF VARIANCE:
COMPARISON OF LARVAL CAPTURE RATES BY STATION,
DIEL PERIOD AND DEPTH
MARTIN PLANT
7 FEBRUARY - 4 APRIL 1978

Source	DF	Sum of squares	Mean square
Model	15	103.136	6.875
Error	237	1624.469	6.854
Corrected Total	252	1727.605	-

Source	DF	Sum of squares[a]	F value	PF > F
Station	3	21.868	1.06	0.366
Period (day vs. night)	1	51.286	7.48	0.006[b]
Depth	1	8.201	1.20	0.275
Station-Period	3	4.580	0.22	0.879
Station-Depth	3	6.847	0.33	0.803
Station-Depth-Period	4	10.351	0.38	0.824

[a]Type I Sum of squares following the procedures of Barr et al. (1976).
[b]Significant at $\alpha = 0.01$.

Potential Recruitment

Fish mortalities due to entrainment with water used for plant cooling generally result from 1) mechanical stresses suffered while passing through the circulating water pumps and condenser tubes, 2) thermal stresses during the sharp rise in water temperatures across the condensers and subsequent drop in temperature in the receiving water body, and 3) chemical stresses such as occur during chlorination.

Since there were no thermal or chemical stresses present, entrainment stresses at the Martin Plant cooling pond intake would be limited to mechanical parameters associated with the intake pumps, and would be considerably less than cooling water intakes. Although no mortality studies were conducted at this site, mortality studies have been conducted at other sites with similar aquatic habitats. These mortality studies were at electric generating stations where entrainment stresses would have been higher than at the Martin Plant pond intake. These showed that many fishes do survive entrainment and that survival rate is species and temperature specific (ABI, 1976a; 1977b).

Data on survival by species from these other studies indicate that many of the entrained fishes at the Martin Plant cooling pond intake probably survived passage through the intake pumps and into the pond. Based upon average larval density, an estimated 250 million larvae may have been removed from the St. Lucie Canal and transported to the cooling pond. Most of these larvae were shad, which have a very low tolerance to mechanical stress. Nevertheless, fishes such as the sunfishes and gobies have been shown to have high tolerance to mechanical stress (ABI, 1976a; 1976b). If only a small percentage of the estimated 250 million fishes survived, there would be sufficient numbers to establish fish populations in the pond.

CONCLUSION

The impact of impingement and entrainment during filling of the Martin Plant cooling pond was not considered to have had any significant deleterious effects on fish populations in the source waters. The source waters from which the pond was filled are extremely productive and the fish species found during the impingement and entrainment studies are abundant in these source waters. Any future impact will be limited to when the pumps are providing pond make-up water to replace seepage and evaporative losses.

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APPENDIX

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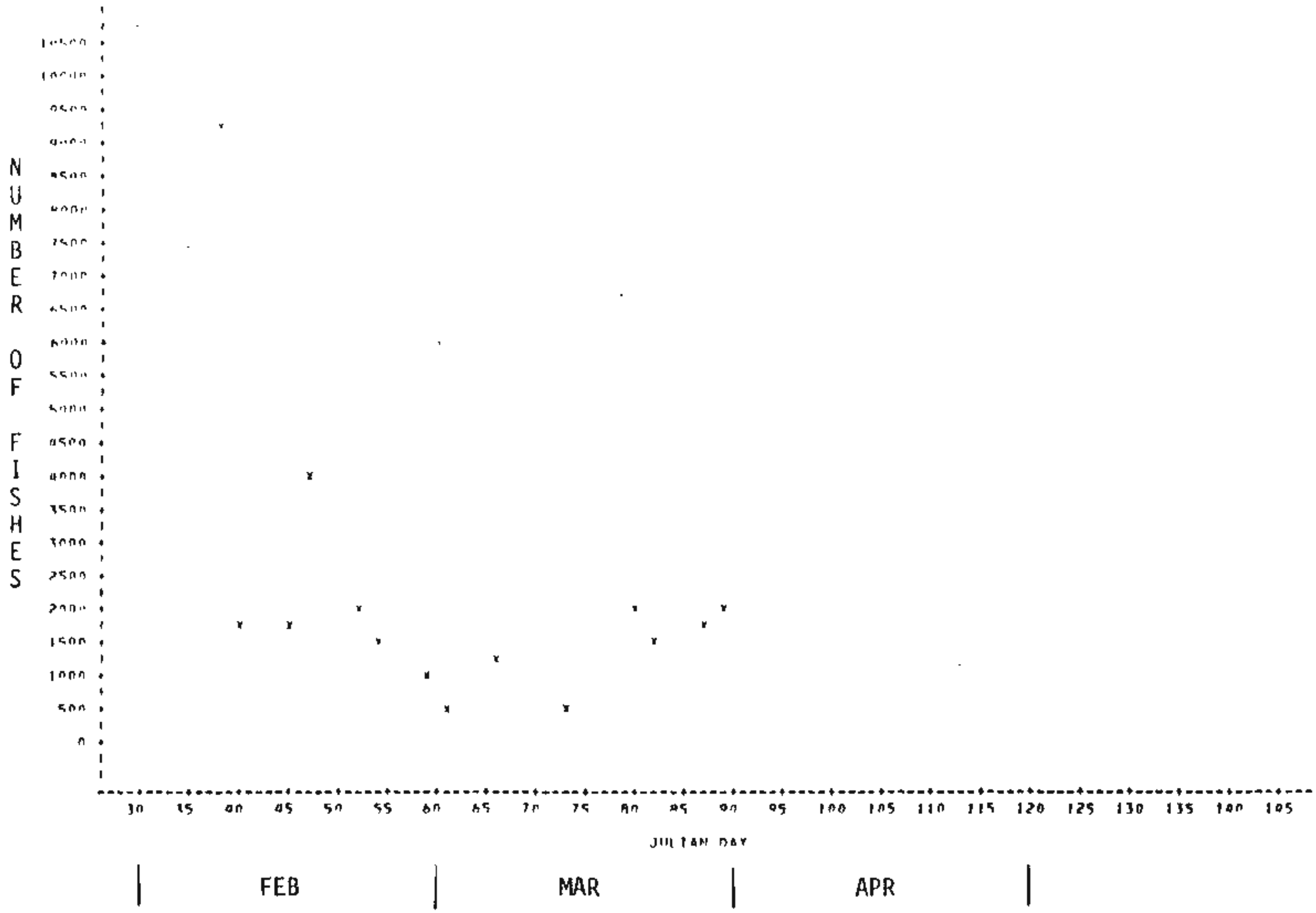
APPENDIX FIGURE 1

NUMBER OF FISHES COLLECTED DURING THE DAY (12-HR) IMPINGEMENT SAMPLES
MARTIN PLANT COOLING POND
6 FEBRUARY - 30 MARCH 1978



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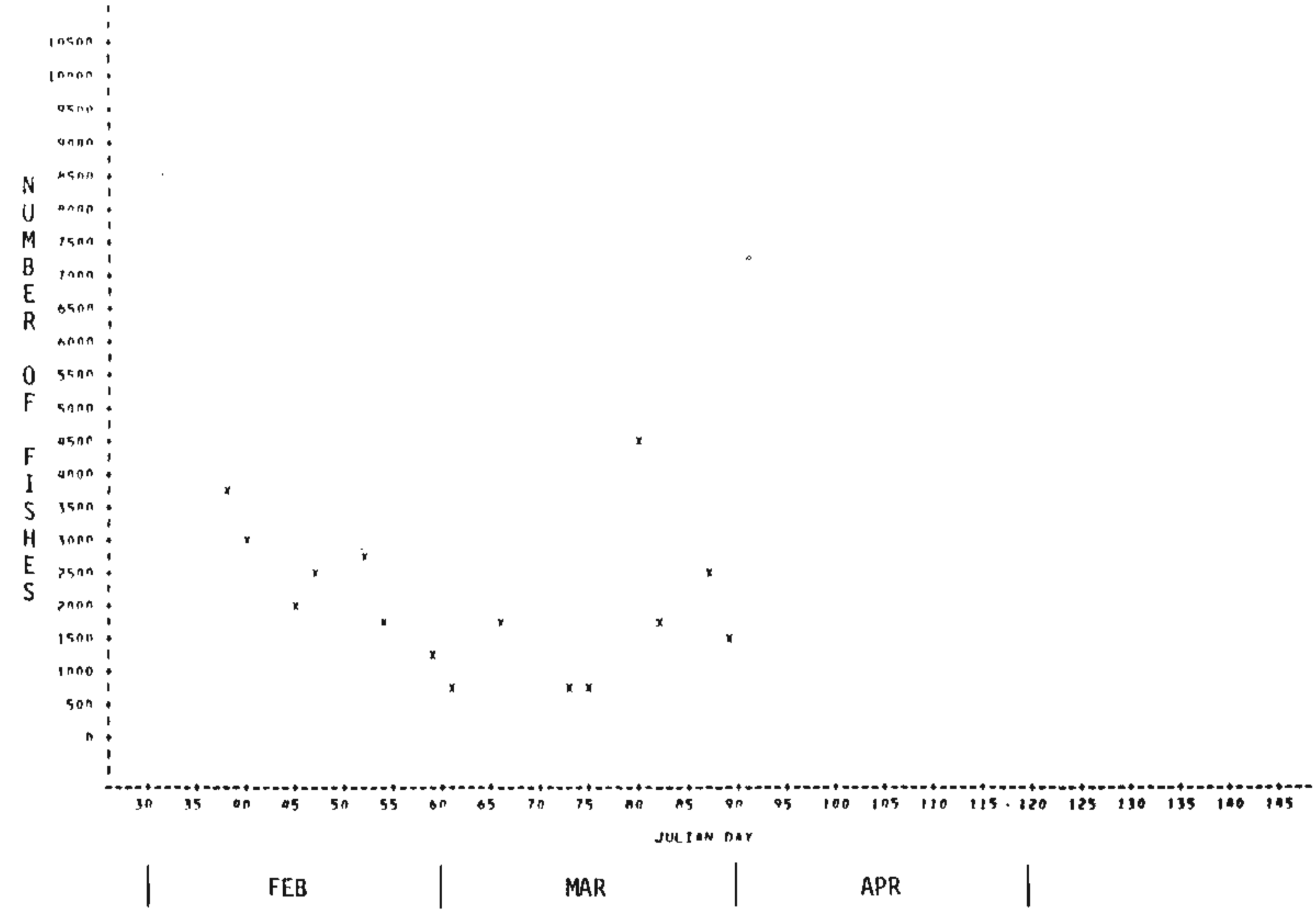
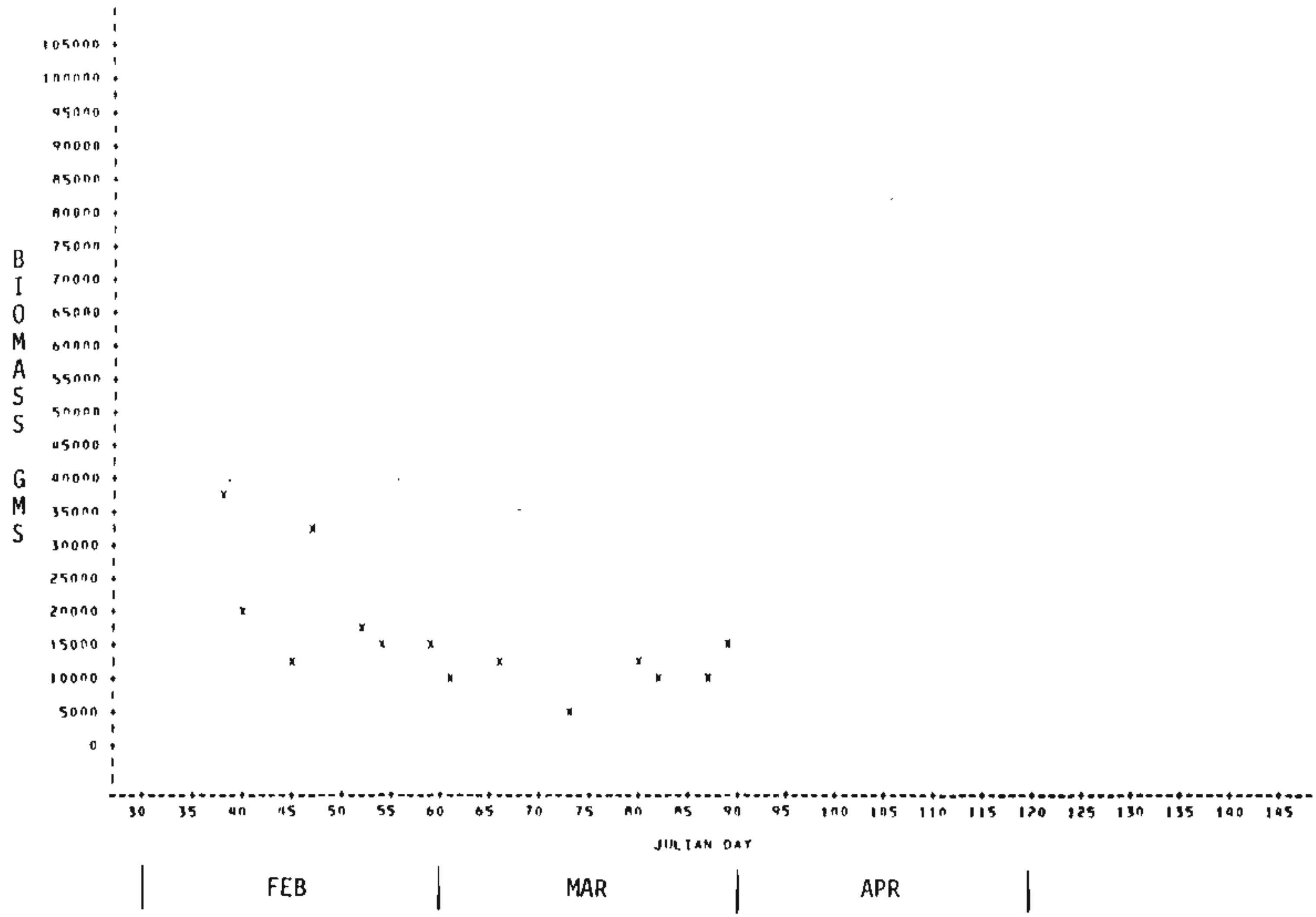
APPENDIX FIGURE 2

NUMBER OF FISHES COLLECTED DURING THE NIGHT (12-HR) IMPINGEMENT SAMPLES
MARTIN PLANT COOLING POND
6 FEBRUARY - 30 MARCH 1978



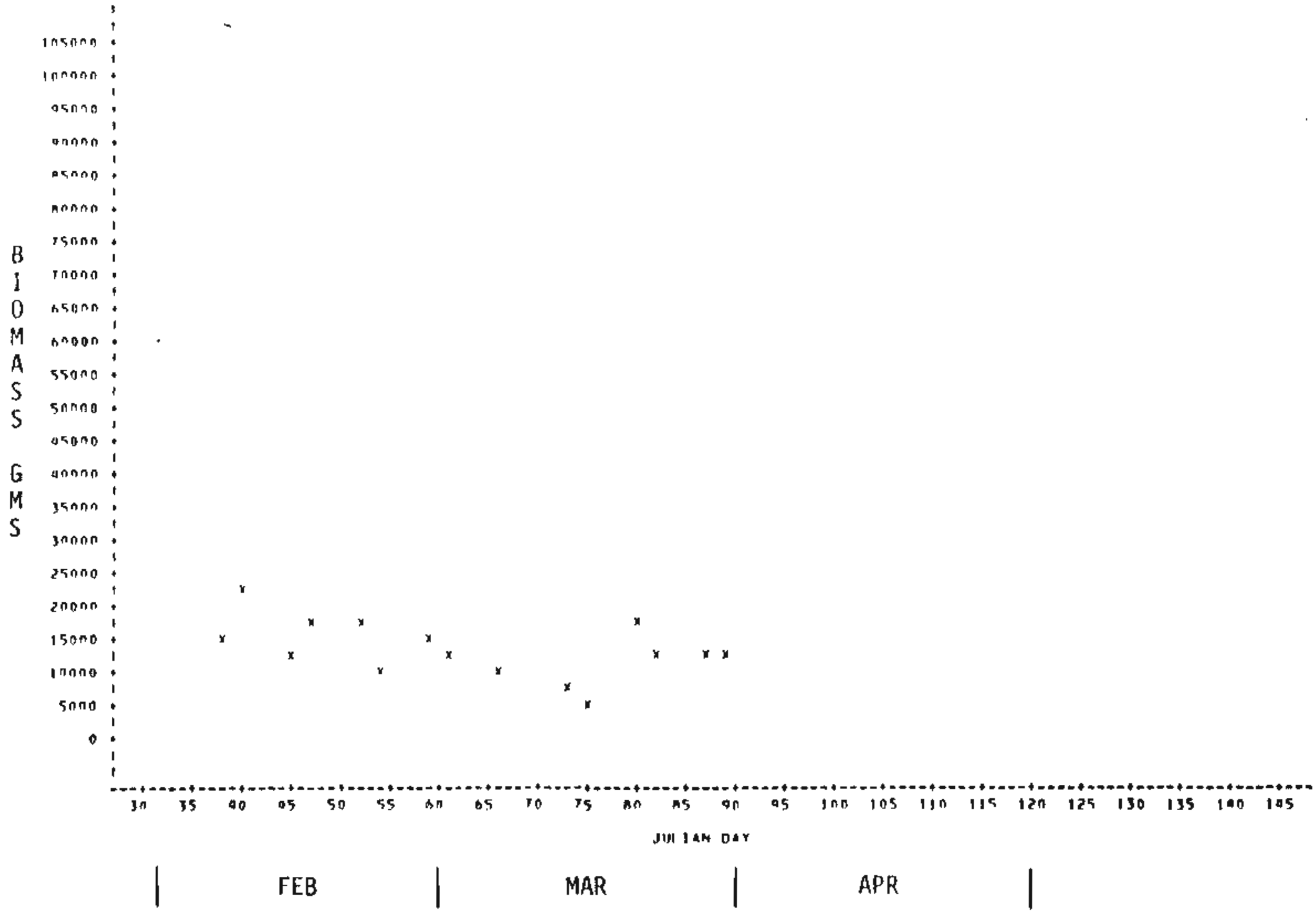
APPENDIX FIGURE 3

BIOMASS OF FISHES COLLECTED DURING THE DAY (12-HR) IMPINGEMENT SAMPLES
MARTIN PLANT COOLING POND
6 FEBRUARY - 30 MARCH 1978



APPENDIX FIGURE 4

BIOMASS OF FISHES COLLECTED DURING THE NIGHT (12-HR) IMPINGEMENT SAMPLES
MARTIN PLANT COOLING POND
6 FEBRUARY - 30 MARCH 1978



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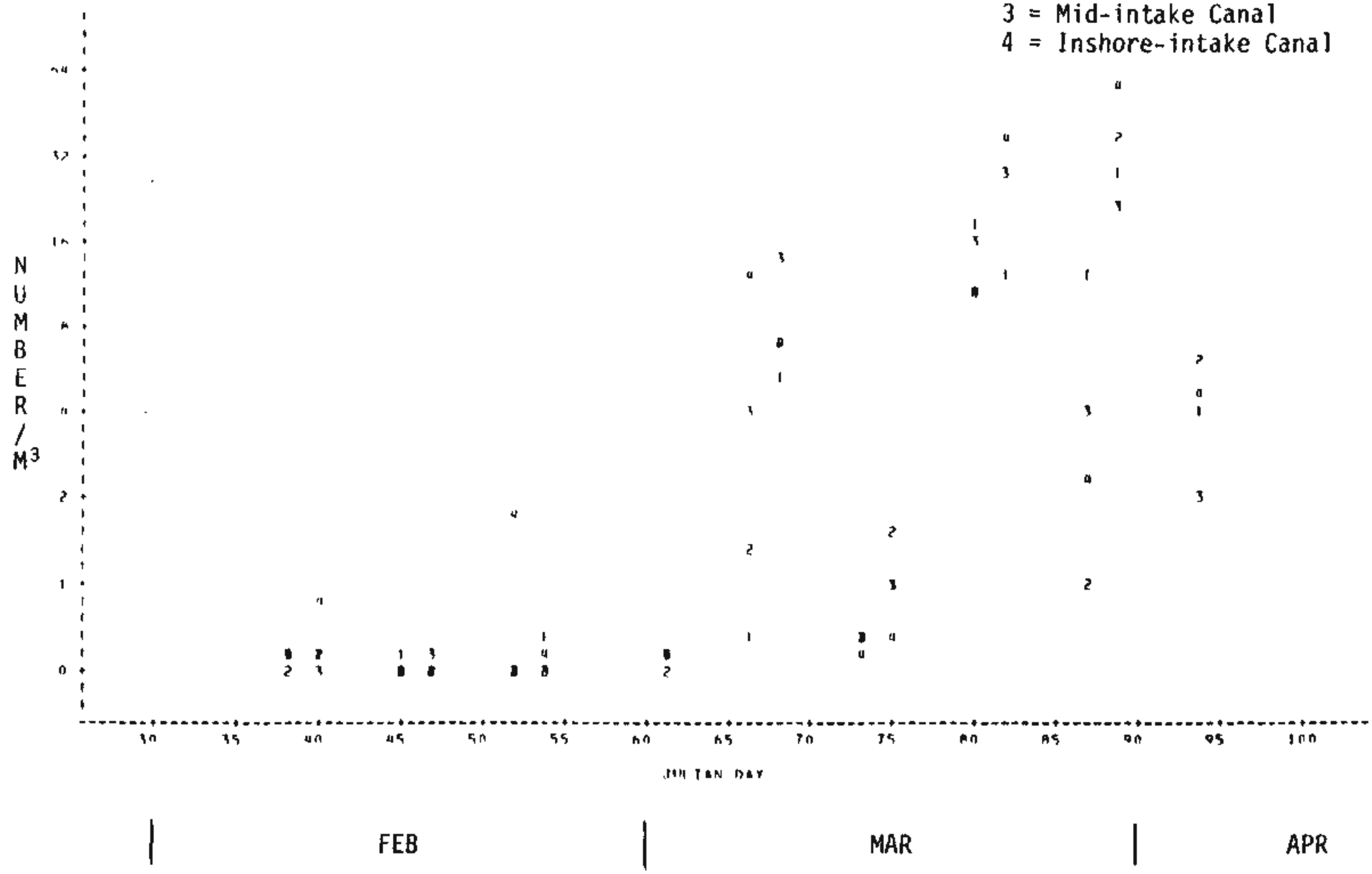
APPENDIX FIGURE 5

LARVAL FISH DENSITIES FOUND DURING ENTRAINMENT SAMPLING
SAMPLES COLLECTED DURING THE DAY AT THE SURFACE
MARTIN PLANT COOLING POND
7 FEBRUARY - 4 APRIL 1978

1 = Mid-St. Lucie Canal
2 = Inshore St. Lucie Canal
3 = Mid-intake Canal
4 = Inshore-intake Canal



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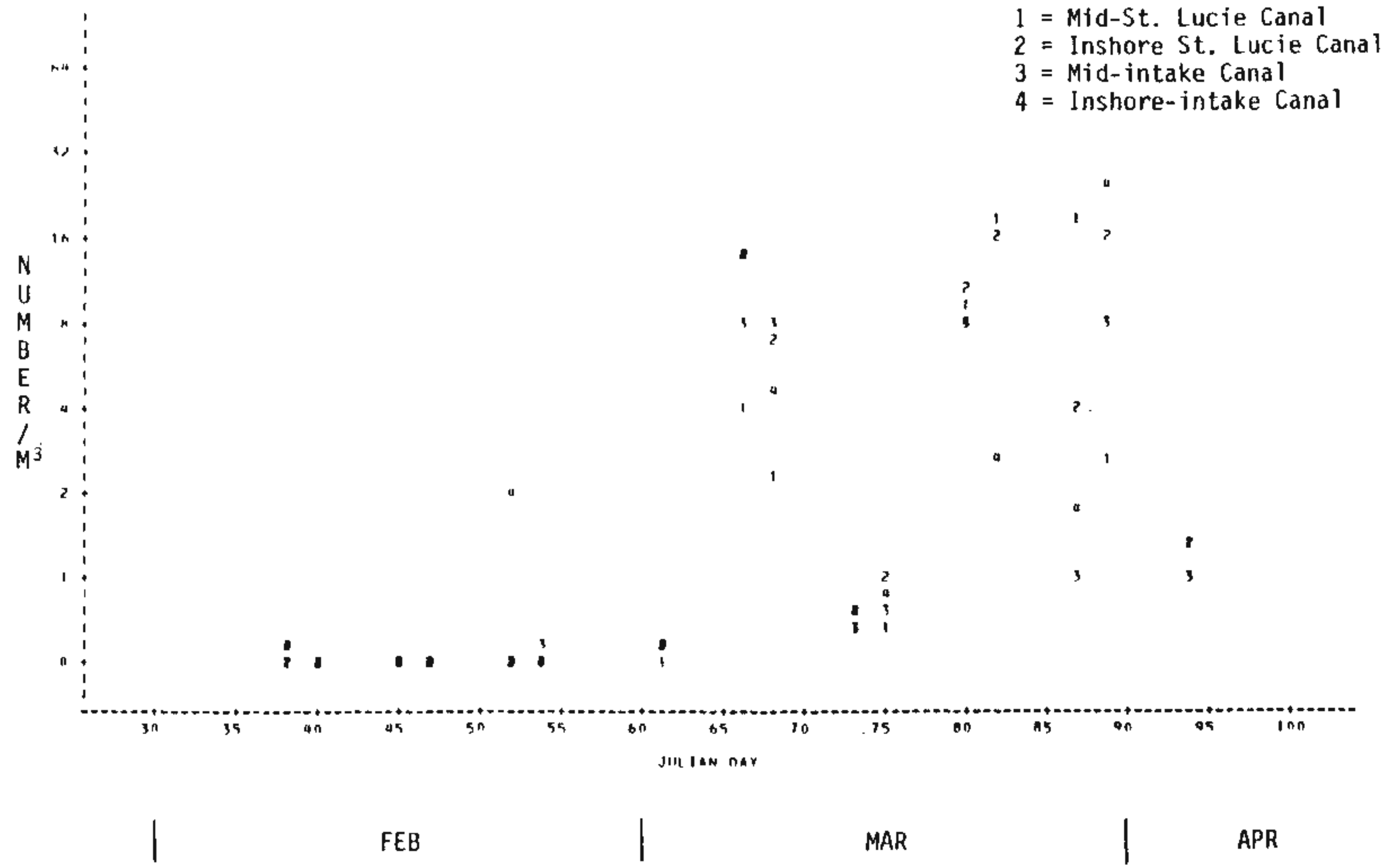
APPENDIX FIGURE 6

LARVAL FISH DENSITIES FOUND DURING ENTRAINMENT SAMPLING
SAMPLES COLLECTED DURING THE DAY AT THE BOTTOM
MARTIN PLANT COOLING POND
7 FEBRUARY - 4 APRIL 1978



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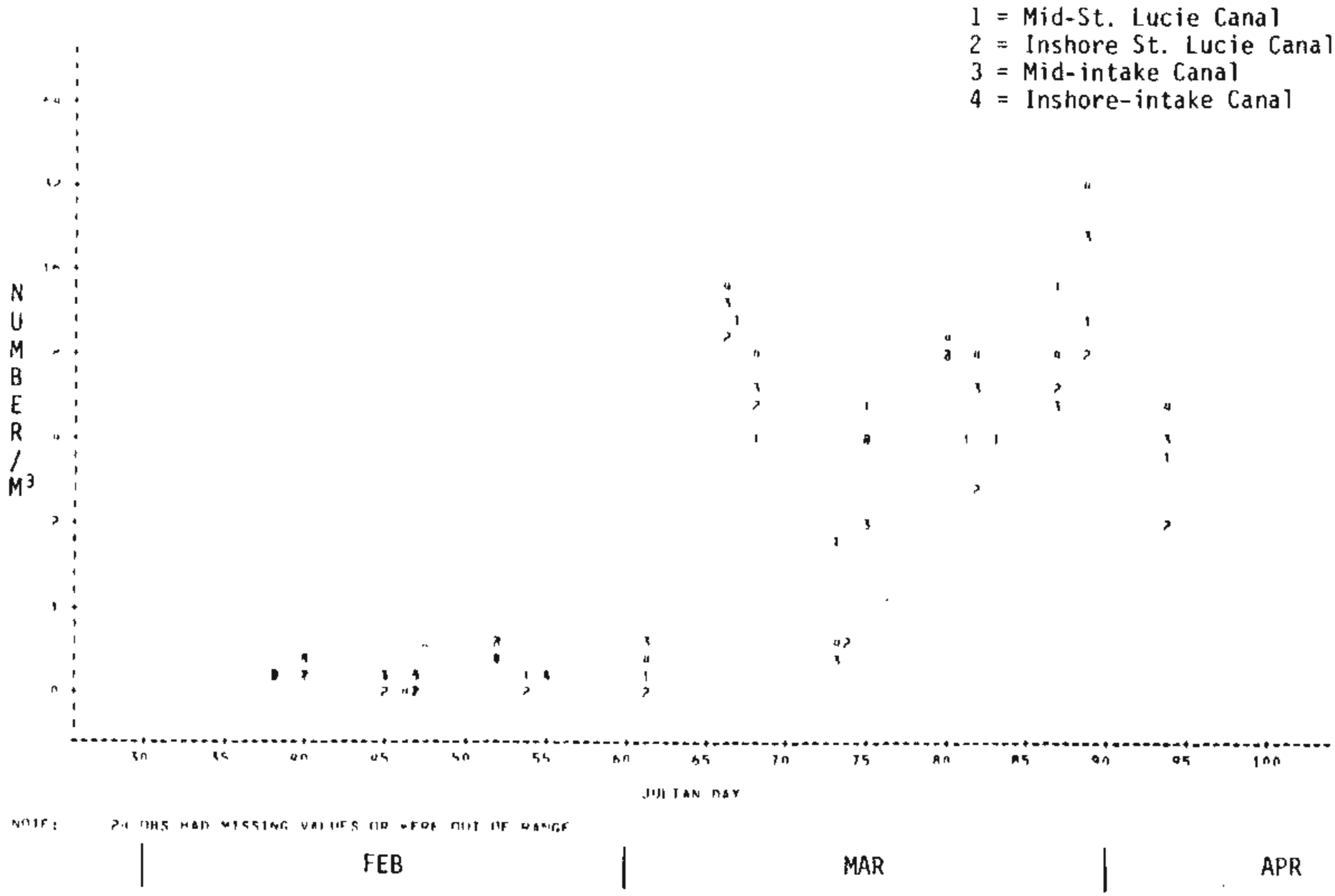
APPENDIX FIGURE 7

LARVAL FISH DENSITIES FOUND DURING ENTRAINMENT SAMPLING
SAMPLES COLLECTED DURING THE NIGHT AT THE SURFACE
MARTIN PLANT COOLING POND
7 FEBRUARY - 4 APRIL 1978



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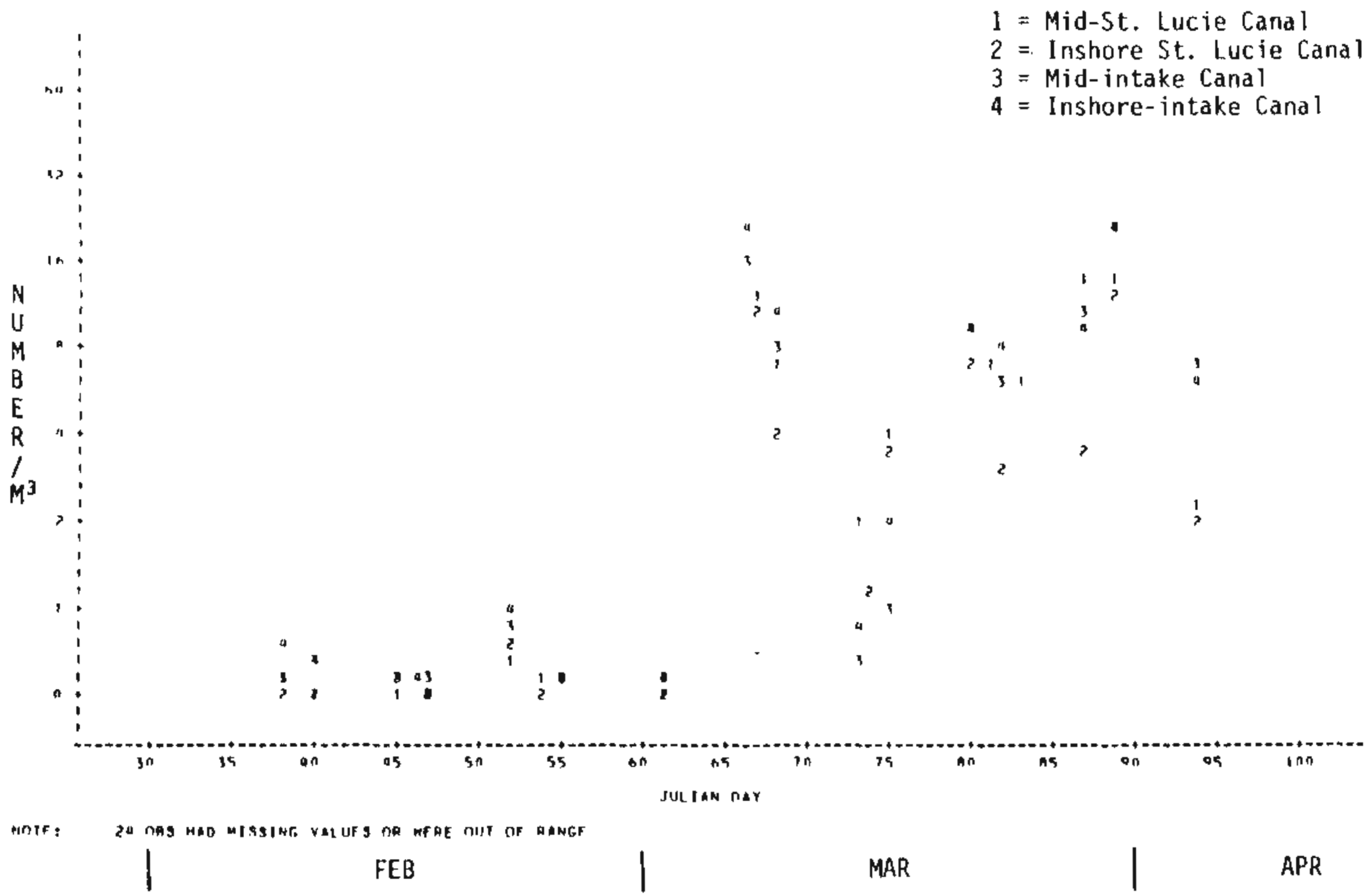
APPENDIX FIGURE 8

LARVAL FISH DENSITIES FOUND DURING ENTRAINMENT SAMPLING
SAMPLES COLLECTED DURING THE NIGHT AT THE BOTTOM
MARTIN PLANT COOLING POND
7 FEBRUARY - 4 APRIL 1978



NOTE: 24 OBS HAD MISSING VALUES OR WERE OUT OF RANGE

APPENDIX TABLE 1

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
6- 7 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	70	8-11	1566
	GIZZARD SHAD	28	12-15	626
	GIZZARD SHAD	4	24-27	984
	THREADFIN SHAD	12	0- 3	6
	THREADFIN SHAD	1788	4- 7	4932
	THREADFIN SHAD	16	8-11	232
	BAY ANCHOVY	44	4- 7	176
	CHANNEL CATFISH	2	4- 7	16
	TADPOLE MADTOM	10	4- 7	30
	SEMINOLE KILLIFISH	2	8-11	29
	TIDEWATER SILVERSIDE	4	0- 3	4
	TIDEWATER SILVERSIDE	4	4- 7	4
	WARMOUTH	2	0- 3	2
	BLUEGILL	556	0- 3	578
	BLUEGILL	6164	4- 7	23052
	BLUEGILL	10	8-11	198
	BLUEGILL	2	12-15	200
	BLUEGILL	2	16-19	214
	REDEAR SUNFISH	212	4- 7	904
	REDEAR SUNFISH	6	8-11	142
	BLACK CRAPPIE	38	4- 7	324
	BLACK CRAPPIE	274	8-11	3540
	CLOWN GOBY	6	4- 7	11
	SUBTOTAL	9256	-	37770
1900-0700	GIZZARD SHAD	1	4- 7	5
	GIZZARD SHAD	44	8-11	657
	GIZZARD SHAD	10	12-15	290
	GIZZARD SHAD	1	16-19	66
	GIZZARD SHAD	9	24-27	2322
	GIZZARD SHAD	1	25-28	260

APPENDIX TABLE 1
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
6- 7 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	THREADFIN SHAD	14	0- 3	10
	THREADFIN SHAD	822	4- 7	1806
	THREADFIN SHAD	18	8-11	221
	BAY ANCHOVY	30	4- 7	115
	WHITE CATFISH	1	8-11	9
	TADPOLE MADTOM	1	4- 7	3
	TIDEWATER SILVERSIDE	12	4- 7	13
	BLUESPOTTED SUNFISH	2	0- 3	4
	BLUEGILL	303	0- 3	343
	BLUEGILL	2399	4- 7	7180
	BLUEGILL	6	8-11	125
	REDEAR SUNFISH	1	0- 3	2
	REDEAR SUNFISH	54	4- 7	247
	BLACK CRAPPIE	12	4- 7	144
	BLACK CRAPPIE	32	8-11	434
	BLACK CRAPPIE	3	16-19	517
	CLOWN GOBY	4	4- 7	8
	SUBTOTAL	3780	-	14781
	TOTAL	13036	-	52551

APPENDIX TABLE 2

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
8- 9 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	8	8-11	99
	GIZZARD SHAD	12	12-15	371
	GIZZARD SHAD	12	20-23	2472
	GIZZARD SHAD	24	24-27	7396
	THREADFIN SHAD	24	0- 3	22
	THREADFIN SHAD	340	4- 7	908
	THREADFIN SHAD	16	8-11	340
	BAY ANCHOVY	36	4- 7	144
	WHITE CATFISH	4	16-19	400
	CHANNEL CATFISH	4	8-11	68
	CHANNEL CATFISH	4	12-15	140
	TADPOLE MADTOM	12	4- 7	46
	ATLANTIC NEEDLEFISH	4	16-19	38
	SEMINOLE KILLIFISH	4	8-11	44
	TIDEWATER SILVERSIDE	8	4- 7	14
	WARMOUTH	4	4- 7	12
	BLUEGILL	144	0- 3	180
	BLUEGILL	932	4- 7	3340
	BLUEGILL	4	8-11	252
	REDEAR SUNFISH	4	0- 3	6
	REDEAR SUNFISH	64	4- 7	288
	REDEAR SUNFISH	4	8-11	89
	BLACK CRAPPIE	28	4- 7	278
	BLACK CRAPPIE	60	8-11	1199
	BLACK CRAPPIE	4	12-15	200
	BLACK CRAPPIE	4	16-19	584
	BLACK CRAPPIE	4	20-23	1308
	CLOWN GOBY	24	4- 7	53
	SUBTOTAL	1792	-	20292

APPENDIX TABLE 2
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
8- 9 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	96	8-11	1796
	GIZZARD SHAD	16	12-15	610
	GIZZARD SHAD	16	24-27	4036
	GIZZARD SHAD	2	25-28	504
	THREADFIN SHAD	14	0- 3	11
	THREADFIN SHAD	866	4- 7	2278
	THREADFIN SHAD	50	8-11	540
	BAY ANCHOVY	144	4- 7	654
	BAY ANCHOVY	2	8-11	10
	GOLDEN SHINER	2	8-11	25
	LAKE CHUBSUCKER	2	20-23	472
	WHITE CATFISH	2	8-11	40
	WHITE CATFISH	2	20-23	76
	CHANNEL CATFISH	2	8-11	6
	CHANNEL CATFISH	2	12-15	6
	TADPOLE MADTOM	2	4- 7	7
	ATLANTIC NEEDLEFISH	2	8-11	9
	ATLANTIC NEEDLEFISH	2	12-15	9
	ATLANTIC NEEDLEFISH	8	16-19	34
	SEMINOLE KILLIFISH	4	8-11	76
	TIDEWATER SILVERSIDE	8	0- 3	8
	TIDEWATER SILVERSIDE	10	4- 7	12
	BLUESPOTTED SUNFISH	2	0- 3	5

APPENDIX TABLE 2
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
8- 9 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	WARMOUTH	2	0- 3	3
	BLUEGILL	330	0- 3	552
	BLUEGILL	1074	4- 7	5212
	BLUEGILL	8	8-11	344
	BLUEGILL	4	12-15	338
	BLUEGILL	2	16-19	254
	REDEAR SUNFISH	96	4- 7	616
	REDEAR SUNFISH	12	8-11	254
	BLACK CRAPPIE	72	4- 7	660
	BLACK CRAPPIE	174	8-11	3870
	BLACK CRAPPIE	2	16-19	244
	NAKED GOBY	2	0- 3	2
	CLOWN GOBY	26	4- 7	52
	SUBTOTAL	3060	-	23625
	TOTAL	4852	-	43917

APPENDIX TABLE 3

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
13-14 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	75	8-11	1132
	GIZZARD SHAD	18	12-15	528
	GIZZARD SHAD	1	16-19	111
	GIZZARD SHAD	1	20-23	213
	GIZZARD SHAD	10	24-27	2853
	GIZZARD SHAD	4	25-28	1263
	THREADFIN SHAD	14	0- 3	14
	THREADFIN SHAD	794	4- 7	1792
	THREADFIN SHAD	29	8-11	371
	BAY ANCHOVY	14	4- 7	52
	WHITE CATFISH	1	12-15	43
	WHITE CATFISH	1	20-23	119
	TADPOLE MADTOM	6	4- 7	27
	WALKING CATFISH	1	16-19	66
	WALKING CATFISH	1	20-23	113
	ATLANTIC NEEDLEFISH	2	4- 7	8
	ATLANTIC NEEDLEFISH	1	20-23	16
	ATLANTIC NEEDLEFISH	1	25-28	172
	SEMINOLE KILLIFISH	5	8-11	59
	TIDEWATER SILVERSIDE	3	4- 7	6
	BLUEGILL	171	0- 3	298
	BLUEGILL	403	4- 7	1507
	BLUEGILL	1	8-11	24
	REDEAR SUNFISH	34	4- 7	73
	BLACK CRAPPIE	2	4- 7	23
	BLACK CRAPPIE	51	8-11	1384
	BLACK CRAPPIE	3	16-19	601
	BLACK CRAPPIE	2	20-23	550
	CLOWN GOBY	4	4- 7	7
	SUBTOTAL	1653	-	13426

APPENDIX TABLE 3
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
13-14 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	2	4- 7	13
	GIZZARD SHAD	82	8-11	1128
	GIZZARD SHAD	27	12-15	850
	GIZZARD SHAD	1	16-19	70
	GIZZARD SHAD	1	20-23	164
	GIZZARD SHAD	15	24-27	3342
	GIZZARD SHAD	5	25-28	1217
	THREADFIN SHAD	23	0- 3	17
	THREADFIN SHAD	1327	4- 7	2744
	THREADFIN SHAD	29	8-11	379
	THREADFIN SHAD	1	12-15	13
	BAY ANCHOVY	39	4- 7	138
	WHITE CATFISH	1	12-15	44
	WHITE CATFISH	1	16-19	89
	CHANNEL CATFISH	1	4- 7	4
	TADPOLE MADTOM	4	4- 7	20
	ATLANTIC NEEDLEFISH	4	16-19	21
	PIPEFISH	2	12-15	5
	BLUEGILL	70	0- 3	100
	BLUEGILL	197	4- 7	734
	BLUEGILL	1	16-19	138
	REDEAR SUNFISH	1	0- 3	4
	REDEAR SUNFISH	12	4- 7	46
	REDEAR SUNFISH	1	8-11	27
	BLACK CRAPPIE	2	4- 7	23
	BLACK CRAPPIE	22	8-11	396
	BLACK CRAPPIE	4	12-15	209
	BLACK CRAPPIE	1	16-19	214
	BLACK CRAPPIE	2	20-23	505
	CLOWN GOBY	3	4- 7	7
	SUBTOTAL	1881	-	12659
	TOTAL	3534	-	26085

APPENDIX TABLE 4

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
15-16 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	1	4- 7	6
	GIZZARD SHAD	72	8-11	1330
	GIZZARD SHAD	11	12-15	394
	GIZZARD SHAD	2	20-23	341
	GIZZARD SHAD	8	24-27	2152
	GIZZARD SHAD	3	25-28	1475
	THREADFIN SHAD	24	0- 3	50
	THREADFIN SHAD	1376	4- 7	3010
	THREADFIN SHAD	71	8-11	1148
	BAY ANCHOVY	56	4- 7	253
	WHITE CATFISH	1	4- 7	3
	CHANNEL CATFISH	1	4- 7	8
	CHANNEL CATFISH	1	8-11	13
	CHANNEL CATFISH	2	12-15	51
	TADPOLE MADTOM	2	4- 7	9
	ATLANTIC NEEDLEFISH	2	12-15	12
	ATLANTIC NEEDLEFISH	3	16-19	21
	SEMINOLE KILLIFISH	1	8-11	12
	TIDEWATER SILVERSIDE	3	0- 3	4
	TIDEWATER SILVERSIDE	3	4- 7	6
	BLUESPOTTED SUNFISH	1	0- 3	2
	BLUEGILL	428	0- 3	765
	BLUEGILL	1421	4- 7	5677
	REDEAR SUNFISH	3	0- 3	5
	REDEAR SUNFISH	68	4- 7	447
	REDEAR SUNFISH	3	8-11	54
	BLACK CRAPPIE	22	4- 7	365
	BLACK CRAPPIE	526	8-11	13318
	BLACK CRAPPIE	1	16-19	163
	BLACK CRAPPIE	2	20-23	721
	CLOWN GOBY	2	4- 7	5
	SUBTOTAL	4120	-	31819

APPENDIX TABLE 4
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
15-16 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	4	4- 7	26
	GIZZARD SHAD	73	8-11	1240
	GIZZARD SHAD	15	12-15	541
	GIZZARD SHAD	6	16-19	390
	GIZZARD SHAD	3	20-23	551
	GIZZARD SHAD	12	24-27	3060
	GIZZARD SHAD	1	25-28	569
	THREADFIN SHAD	19	0- 3	46
	THREADFIN SHAD	1118	4- 7	2731
	THREADFIN SHAD	47	8-11	595
	THREADFIN SHAD	1	12-15	13
	BAY ANCHOVY	49	4- 7	222
	BAY ANCHOVY	1	8-11	5
	CHANNEL CATFISH	2	8-11	25
	CHANNEL CATFISH	1	12-15	37
	TADPOLE MADTOM	3	4- 7	14
	ATLANTIC NEEDLEFISH	1	8-11	4
	ATLANTIC NEEDLEFISH	1	12-15	5
	ATLANTIC NEEDLEFISH	3	16-19	15
	SEMINOLE KILLIFISH	1	4- 7	15
	SEMINOLE KILLIFISH	3	8-11	51
	TIDEWATER SILVERSIDE	2	4- 7	3
	BLUEGILL	129	0- 3	225
	BLUEGILL	796	4- 7	3373
	REDEAR SUNFISH	1	0- 3	1
	REDEAR SUNFISH	39	4- 7	187
	REDEAR SUNFISH	1	8-11	30
	BLACK CRAPPIE	8	4- 7	98
	BLACK CRAPPIE	185	8-11	4124
	BLACK CRAPPIE	1	12-15	49
	CLOWN GOBY	2	4- 7	5
	SUBTOTAL	2528	-	18250
	TOTAL	6648	-	50069

APPENDIX TABLE 5

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
20-21 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	1	4- 7	12
	GIZZARD SHAD	59	8-11	850
	GIZZARD SHAD	17	12-15	525
	GIZZARD SHAD	1	16-19	72
	GIZZARD SHAD	1	20-23	198
	GIZZARD SHAD	2	24-27	649
	GIZZARD SHAD	2	25-28	756
	THREADFIN SHAD	8	0- 3	22
	THREADFIN SHAD	475	4- 7	1304
	THREADFIN SHAD	39	8-11	485
	THREADFIN SHAD	1	12-15	13
	BAY ANCHOVY	26	4- 7	117
	LAKE CHUBSUCKER	1	20-23	261
	CHANNEL CATFISH	3	8-11	40
	TADPOLE MADTOM	2	4- 7	13
	ATLANTIC NEEDLEFISH	1	12-15	4
	ATLANTIC NEEDLEFISH	2	16-19	9
	SEMINOLE KILLIFISH	1	8-11	17
	TIDEWATER SILVERSIDE	2	4- 7	3
	PIPEFISH	1	12-15	2
	BLUEGILL	51	0- 3	76
	BLUEGILL	857	4- 7	4402
	BLUEGILL	3	8-11	98

APPENDIX TABLE 5
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
20-21 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	REDEAR SUNFISH	4	0- 3	8
	REDEAR SUNFISH	35	4- 7	177
	REDEAR SUNFISH	2	8-11	37
	BLACK CRAPPIE	14	4- 7	167
	BLACK CRAPPIE	244	8-11	2880
	BLACK CRAPPIE	41	12-15	3260
	BLACK CRAPPIE	2	16-19	418
	BLACK CRAPPIE	1	20-23	258
	CLOWN GOBY	1	4- 7	2
	SUBTOTAL	1900	-	17133
1900-0700	GIZZARD SHAD	61	8-11	1009
	GIZZARD SHAD	17	12-15	37
	GIZZARD SHAD	1	16-19	623
	GIZZARD SHAD	1	20-23	145
	GIZZARD SHAD	8	24-27	2160
	GIZZARD SHAD	4	25-28	1574
	THREADFIN SHAD	18	0- 3	36
	THREADFIN SHAD	1087	4- 7	2686
	THREADFIN SHAD	49	8-11	598
	BAY ANCHOVY	59	4- 7	265
	WHITE CATFISH	1	12-15	45
	CHANNEL CATFISH	2	8-11	39
	ATLANTIC NEEDLEFISH	2	12-15	10
	ATLANTIC NEEDLEFISH	4	16-19	21
	TIDEWATER SILVERSIDE	4	4- 7	6
	BLUESPOTTED SUNFISH	1	0- 3	2
	WARMOUTH	1	4- 7	4
	BLUEGILL	125	0- 3	187
	BLUEGILL	1007	4- 7	3632
	BLUEGILL	4	8-11	148

APPENDIX TABLE 5
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
20-21 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	BLUEGILL	1	12-15	148
	REDEAR SUNFISH	4	0- 3	7
	REDEAR SUNFISH	44	4- 7	184
	REDEAR SUNFISH	1	8-11	26
	REDEAR SUNFISH	1	12-15	159
	BLACK CRAPPIE	54	4- 7	551
	BLACK CRAPPIE	136	8-11	3604
	BLACK CRAPPIE	2	12-15	102
	BLACK CRAPPIE	2	16-19	276
	NAKED GOBY	1	0- 3	2
	CLOWN GOBY	1	0- 3	2
	CLOWN GOBY	3	4- 7	7
	SUBTOTAL	2706	-	18295
	TOTAL	4606	-	35428

APPENDIX TABLE 6

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
22-23 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	43	8-11	741
	GIZZARD SHAD	11	12-15	371
	GIZZARD SHAD	6	24-27	1444
	GIZZARD SHAD	2	25-28	655
	THREADFIN SHAD	2	0- 3	4
	THREADFIN SHAD	323	4- 7	991
	THREADFIN SHAD	34	8-11	533
	THREADFIN SHAD	1	12-15	16
	BAY ANCHOVY	22	4- 7	112
	GOLDEN SHINER	1	20-23	178
	WHITE CATFISH	1	4- 7	9
	WHITE CATFISH	1	8-11	38
	CHANNEL CATFISH	1	8-11	10
	TADPOLE MADTOM	3	4- 7	15
	TIDEWATER SILVERSIDE	2	4- 7	3
	BLUEGILL	116	0- 3	190
	BLUEGILL	599	4- 7	3061
	BLUEGILL	2	8-11	56
	BLUEGILL	2	12-15	279
	BLUEGILL	2	16-19	280
	REDEAR SUNFISH	28	4- 7	152
	REDEAR SUNFISH	2	8-11	45
	BLACK CRAPPIE	34	4- 7	440
	BLACK CRAPPIE	180	8-11	4292
	CLOWN GOBY	2	4- 7	6
	SUBTOTAL	1420	-	13919
1900-0700	GIZZARD SHAD	3	4- 7	19
	GIZZARD SHAD	51	8-11	878
	GIZZARD SHAD	9	12-15	366
	GIZZARD SHAD	1	16-19	44

APPENDIX TABLE 6
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
22-23 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	5	24-27	1201
	GIZZARD SHAD	1	25-28	241
	THREADFIN SHAD	1	0- 3	2
	THREADFIN SHAD	737	4- 7	1663
	THREADFIN SHAD	23	8-11	346
	THREADFIN SHAD	1	12-15	16
	BAY ANCHOVY	23	4- 7	103
	BAY ANCHOVY	1	8-11	5
	WHITE CATFISH	1	8-11	27
	WHITE CATFISH	1	12-15	50
	CHANNEL CATFISH	1	8-11	19
	TADPOLE MADTOM	2	4- 7	7
	ATLANTIC NEEDLEFISH	1	16-19	10
	SEMINOLE KILLIFISH	2	8-11	22
	BLUEGILL	191	0- 3	332
	BLUEGILL	654	4- 7	2953
	BLUEGILL	1	8-11	50
	BLUEGILL	1	12-15	57
	REDEAR SUNFISH	2	0- 3	3
	REDEAR SUNFISH	29	4- 7	171
	BLACK CRAPPIE	13	4- 7	162
	BLACK CRAPPIE	82	8-11	1793
	BLACK CRAPPIE	2	12-15	135
	BLACK CRAPPIE	1	16-19	168
	CLOWN GOBY	1	4- 7	2
	SUBTOTAL	1841	-	10846
	TOTAL	3261	-	24765

APPENDIX TABLE 7

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
27-28 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	42	8-11	641
	GIZZARD SHAD	19	12-15	199
	GIZZARD SHAD	1	20-23	270
	GIZZARD SHAD	11	24-27	3020
	THREADFIN SHAD	2	0- 3	4
	THREADFIN SHAD	331	4- 7	984
	THREADFIN SHAD	24	8-11	380
	BAY ANCHOVY	3	4- 7	12
	WHITE CATFISH	1	16-19	121
	CHANNEL CATFISH	1	8-11	19
	CHANNEL CATFISH	1	12-15	35
	TADPOLE MADTOM	1	4- 7	5
	ATLANTIC NEEDLEFISH	5	12-15	30
	ATLANTIC NEEDLEFISH	3	20-23	23
	TIDEWATER SILVERSIDE	1	4- 7	1
	BLUEGILL	24	0- 3	41
	BLUEGILL	150	4- 7	861
	BLUEGILL	2	8-11	70
	BLUEGILL	4	12-15	563
	BLUEGILL	1	16-19	166
	REDEAR SUNFISH	13	4- 7	95
	REDEAR SUNFISH	1	8-11	50
	BLACK CRAPPIE	30	4- 7	353
	BLACK CRAPPIE	207	8-11	5595
	BLACK CRAPPIE	10	12-15	645
	BLACK CRAPPIE	2	16-19	361
	CLOWN GOBY	1	4- 7	2
	SUBTOTAL	891	-	14545
1900-0700	GIZZARD SHAD	60	8-11	995
	GIZZARD SHAD	16	12-15	581

APPENDIX TABLE 7
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
27-28 FEBRUARY 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	11	24-27	3089
	GIZZARD SHAD	1	25-28	351
	THREADFIN SHAD	4	0- 3	8
	THREADFIN SHAD	755	4- 7	1927
	THREADFIN SHAD	35	8-11	574
	BAY ANCHOVY	8	4- 7	40
	BAY ANCHOVY	1	8-11	5
	WHITE CATFISH	2	12-15	116
	WHITE CATFISH	1	16-19	108
	CHANNEL CATFISH	3	4- 7	20
	TADPOLE MADTOM	2	4- 7	13
	ATLANTIC NEEDLEFISH	9	8-11	61
	TIDEWATER SILVERSIDE	3	4- 7	5
	BLUEGILL	58	0- 3	109
	BLUEGILL	196	4- 7	978
	BLUEGILL	1	8-11	40
	BLUEGILL	2	12-15	358
	BLUEGILL	2	16-19	359
	REDEAR SUNFISH	3	0- 3	5
	REDEAR SUNFISH	19	4- 7	96
	REDEAR SUNFISH	1	8-11	21
	BLACK CRAPPIE	31	4- 7	378
	BLACK CRAPPIE	127	8-11	2833
	BLACK CRAPPIE	7	12-15	479
	BLACK CRAPPIE	1	20-23	463
	CLOWN GOBY	2	4- 7	4
	SUBTOTAL	1361	-	14015
	TOTAL	2252	-	28560

APPENDIX TABLE 8

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
1- 2 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	3	4- 7	21
	GIZZARD SHAD	34	8-11	560
	GIZZARD SHAD	11	12-15	374
	GIZZARD SHAD	1	20-23	148
	GIZZARD SHAD	6	24-27	1499
	GIZZARD SHAD	3	25-28	1196
	THREADFIN SHAD	2	0- 3	3
	THREADFIN SHAD	157	4- 7	826
	THREADFIN SHAD	27	8-11	521
	BAY ANCHOVY	5	4- 7	19
	WHITE CATFISH	1	8-11	13
	WHITE CATFISH	1	20-23	161
	CHANNEL CATFISH	1	4- 7	6
	CHANNEL CATFISH	1	12-15	22
	CHANNEL CATFISH	1	16-19	70
	TADPOLE MADTOM	1	4- 7	6
	ATLANTIC NEEDLEFISH	2	12-15	10
	ATLANTIC NEEDLEFISH	2	16-19	10
	BLUEGILL	21	0- 3	35
	BLUEGILL	174	4- 7	929
	BLUEGILL	2	8-11	39
	BLUEGILL	1	16-19	153
	REDEAR SUNFISH	1	0- 3	1
	REDEAR SUNFISH	14	4- 7	57
	BLACK CRAPPIE	6	4- 7	81
	BLACK CRAPPIE	119	8-11	2904
	BLACK CRAPPIE	4	12-15	312
	BLACK CRAPPIE	1	16-19	143
	NAKED GOBY	1	0- 3	2
	SUBTOTAL	603	-	10122

APPENDIX TABLE 8
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
1- 2 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	35	8-11	631
	GIZZARD SHAD	15	12-15	567
	GIZZARD SHAD	1	16-19	76
	GIZZARD SHAD	3	20-23	387
	GIZZARD SHAD	9	24-27	2633
	THREADFIN SHAD	451	4- 7	1262
	THREADFIN SHAD	23	8-11	381
	BAY ANCHOVY	3	4- 7	12
	WHITE CATFISH	1	12-15	89
	WHITE CATFISH	1	24-27	319
	CHANNEL CATFISH	1	8-11	16
	CHANNEL CATFISH	1	20-23	95
	SEMINOLE KILLIFISH	2	8-11	21
	BLUEGILL	41	0- 3	70
	BLUEGILL	157	4- 7	804
	BLUEGILL	1	12-15	139
	BLUEGILL	1	16-19	181
	REDEAR SUNFISH	1	0- 3	1
	REDEAR SUNFISH	10	4- 7	44
	REDEAR SUNFISH	1	8-11	34
	BLACK CRAPPIE	5	4- 7	59
	BLACK CRAPPIE	80	8-11	2024
	BLACK CRAPPIE	7	12-15	426
	BLACK CRAPPIE	4	16-19	735
	BLACK CRAPPIE	4	20-23	1008
	CLOWN GOBY	2	4- 7	4
	SUBTOTAL	860	-	12017
	TOTAL	1463	-	22139

APPENDIX TABLE 9

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
6- 7 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	45	8-11	837
	GIZZARD SHAD	16	12-15	568
	GIZZARD SHAD	4	16-19	267
	GIZZARD SHAD	2	20-23	290
	GIZZARD SHAD	8	24-27	2355
	GIZZARD SHAD	3	25-28	1044
	THREADFIN SHAD	4	0- 3	4
	THREADFIN SHAD	431	4- 7	1173
	THREADFIN SHAD	32	8-11	524
	THREADFIN SHAD	1	12-15	17
	BAY ANCHOVY	11	4- 7	46
	WHITE CATFISH	1	24-27	384
	CHANNEL CATFISH	1	12-15	34
	TADPOLE MADTOM	4	4- 7	16
	ATLANTIC NEEDLEFISH	1	12-15	3
	ATLANTIC NEEDLEFISH	1	20-23	9
	PIPEFISH	1	12-15	2
	WARMOUTH	1	4- 7	2
	BLUEGILL	108	0- 3	160
	BLUEGILL	575	4- 7	2340
	BLUEGILL	1	16-19	157
	REDEAR SUNFISH	22	4- 7	89
	REDEAR SUNFISH	1	12-15	63
	BLACK CRAPPIE	2	4- 7	21
	BLACK CRAPPIE	79	8-11	1952
	BLACK CRAPPIE	3	12-15	187
	BLACK CRAPPIE	4	16-19	774
	BLACK CRAPPIE	1	20-23	195
	CLOWN GOBY	1	0- 3	1
	CLOWN GOBY	2	4- 7	5
	SUBTOTAL	1366	-	13521

APPENDIX TABLE 9
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
6- 7 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	53	8-11	828
	GIZZARD SHAD	16	12-15	472
	GIZZARD SHAD	1	16-19	61
	GIZZARD SHAD	4	24-27	1158
	THREADFIN SHAD	15	0- 3	20
	THREADFIN SHAD	758	4- 7	1912
	THREADFIN SHAD	23	8-11	365
	BAY ANCHOVY	14	4- 7	72
	WHITE CATFISH	1	8-11	28
	CHANNEL CATFISH	1	4- 7	8
	CHANNEL CATFISH	2	12-15	105
	ATLANTIC NEEDLEFISH	1	12-15	4
	ATLANTIC NEEDLEFISH	2	16-19	14
	SEMINOLE KILLIFISH	1	8-11	20
	TIDEWATER SILVERSIDE	3	4- 7	4
	BLUEGILL	66	0- 3	83
	BLUEGILL	593	4- 7	1851
	BLUEGILL	1	8-11	31
	BLUEGILL	1	12-15	116
	BLUEGILL	3	16-19	446
	REDEAR SUNFISH	2	0- 3	3
	REDEAR SUNFISH	20	4- 7	100
	REDEAR SUNFISH	1	12-15	128
	BLACK CRAPPIE	2	4- 7	23
	BLACK CRAPPIE	58	8-11	1378
	BLACK CRAPPIE	2	12-15	150
	BLACK CRAPPIE	2	16-19	309
	BLACK CRAPPIE	3	20-23	900
	NAKED GOBY	1	0- 3	1
	SUBTOTAL	1650	-	10590
	TOTAL	3016	-	24110

APPENDIX TABLE 10

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
13-14 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	29	8-11	54
	GIZZARD SHAD	13	12-15	473
	GIZZARD SHAD	1	16-19	61
	GIZZARD SHAD	2	24-27	444
	GIZZARD SHAD	1	25-28	347
	THREADFIN SHAD	66	4- 7	170
	THREADFIN SHAD	8	8-11	133
	BAY ANCHOVY	4	4- 7	15
	WHITE CATFISH	1	20-23	167
	CHANNEL CATFISH	1	4- 7	4
	CHANNEL CATFISH	2	8-11	31
	CHANNEL CATFISH	1	12-15	23
	TADPOLE MADTOM	1	4- 7	6
	ATLANTIC NEEDLEFISH	1	20-23	10
	TIDEWATER SILVERSIDE	2	4- 7	5
	BLUEGILL	36	0- 3	50
	BLUEGILL	219	4- 7	732
	REDEAR SUNFISH	4	4- 7	25
	BLACK CRAPPIE	6	4- 7	66
	BLACK CRAPPIE	66	8-11	1425
	BLACK CRAPPIE	1	12-15	93
	BLACK CRAPPIE	3	16-19	529
	CLOWN GOBY	1	4- 7	1
	SUBTOTAL	469	-	4864
1900-0700	GIZZARD SHAD	43	8-11	693
	GIZZARD SHAD	17	12-15	556
	GIZZARD SHAD	1	20-23	128
	GIZZARD SHAD	3	24-27	794
	GIZZARD SHAD	1	25-28	422
	THREADFIN SHAD	2	0- 3	1

APPENDIX TABLE 10
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
13-14 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	THREADFIN SHAD	195	4- 7	463
	THREADFIN SHAD	10	8-11	158
	BAY ANCHOVY	9	4- 7	33
	WHITE CATFISH	1	12-15	62
	WHITE CATFISH	2	16-19	251
	CHANNEL CATFISH	3	4- 7	13
	TADPOLE MADTOM	1	4- 7	4
	ATLANTIC NEEDLEFISH	1	12-15	4
	TIDEWATER SILVERSIDE	1	4- 7	1
	BLUEGILL	23	0- 3	32
	BLUEGILL	288	4- 7	912
	BLUEGILL	1	12-15	138
	REDEAR SUNFISH	4	4- 7	23
	LARGEMOUTH BASS	1	8-11	26
	BLACK CRAPPIE	4	4- 7	42
	BLACK CRAPPIE	46	8-11	1039
	BLACK CRAPPIE	8	12-15	519
	BLACK CRAPPIE	6	16-19	887
	NAKED GOBY	1	0- 3	0
	SUBTOTAL	672	-	7201
	TOTAL	1141	-	12065

APPENDIX TABLE 11

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
15-16 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	1	4- 7	6
	GIZZARD SHAD	19	8-11	307
	GIZZARD SHAD	16	12-15	187
	GIZZARD SHAD	2	16-19	144
	GIZZARD SHAD	2	25-28	775
	THREADFIN SHAD	2	0- 3	3
	THREADFIN SHAD	236	4- 7	603
	THREADFIN SHAD	17	8-11	233
	BAY ANCHOVY	6	4- 7	31
	GOLDEN SHINER	1	24-27	364
	CHANNEL CATFISH	1	4- 7	6
	CHANNEL CATFISH	1	12-15	30
	TADPOLE MADTOM	2	4- 7	14
	TIDEWATER SILVERSIDE	2	4- 7	2
	BLUEGILL	32	0- 3	51
	BLUEGILL	246	4- 7	846
	BLUEGILL	2	8-11	41
	BLUEGILL	3	16-19	439
	REDEAR SUNFISH	4	4- 7	31
	BLACK CRAPPIE	6	4- 7	77
	BLACK CRAPPIE	34	8-11	851
	BLACK CRAPPIE	3	12-15	257
	BLACK CRAPPIE	3	16-19	617
	BLACK CRAPPIE	1	20-23	297
	CLOWN GOBY	1	4- 7	2
	SUBTOTAL	643	-	6213
	TOTAL	643	-	6213

APPENDIX TABLE 12

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
20-21 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	19	8-11	339
	GIZZARD SHAD	11	12-15	382
	GIZZARD SHAD	1	16-19	92
	GIZZARD SHAD	1	20-23	179
	GIZZARD SHAD	5	24-27	1193
	GIZZARD SHAD	4	25-28	892
	THREADFIN SHAD	3	0- 3	2
	THREADFIN SHAD	187	4- 7	441
	THREADFIN SHAD	13	8-11	160
	BAY ANCHOVY	5	4- 7	27
	BAY ANCHOVY	1	8-11	6
	WHITE CATFISH	2	12-15	132
	WHITE CATFISH	1	16-19	103
	WHITE CATFISH	1	24-27	283
	CHANNEL CATFISH	1	4- 7	4
	CHANNEL CATFISH	3	8-11	37
	CHANNEL CATFISH	1	16-19	69
	TADPOLE MADTOM	4	4- 7	23
	TIDEWATER SILVERSIDE	2	4- 7	2
	BLUESPOTTED SUNFISH	1	0- 3	2
	BLUEGILL	427	0- 3	614
	BLUEGILL	1296	4- 7	4073
	BLUEGILL	5	8-11	164
	BLUEGILL	1	12-15	190
	REDEAR SUNFISH	4	0- 3	5
	REDEAR SUNFISH	51	4- 7	198
	REDEAR SUNFISH	1	16-19	207
	BLACK CRAPPIE	1	4- 7	14
	BLACK CRAPPIE	33	8-11	978
	BLACK CRAPPIE	9	12-15	531
	CLOWN GOBY	1	4- 7	2
	SUBTOTAL	2095	-	11344

APPENDIX TABLE 12
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
20-21 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	30	8-11	608
	GIZZARD SHAD	12	12-15	461
	GIZZARD SHAD	1	20-23	156
	GIZZARD SHAD	5	24-27	1484
	GIZZARD SHAD	4	25-28	1530
	THREADFIN SHAD	2	0- 3	1
	THREADFIN SHAD	939	4- 7	2121
	THREADFIN SHAD	22	8-11	286
	BAY ANCHOVY	14	4- 7	73
	BAY ANCHOVY	1	8-11	6
	WHITE CATFISH	1	12-15	189
	CHANNEL CATFISH	2	4- 7	14
	CHANNEL CATFISH	2	8-11	53
	CHANNEL CATFISH	1	12-15	177
	TADPOLE MADTOM	7	4- 7	50
	ATLANTIC NEEDLEFISH	1	20-23	14
	SEMINOLE KILLIFISH	1	8-11	10
	TIDEWATER SILVERSIDE	1	0- 3	1
	TIDEWATER SILVERSIDE	1	4- 7	1
	BLUEGILL	866	0- 3	1266
	BLUEGILL	2469	4- 7	7388
	BLUEGILL	1	16-19	145
	REDEAR SUNFISH	3	0- 3	4
	REDEAR SUNFISH	144	4- 7	603
	REDEAR SUNFISH	2	8-11	58
	BLACK CRAPPIE	3	4- 7	43
	BLACK CRAPPIE	28	8-11	719
	BLACK CRAPPIE	3	16-19	448
	NAKED GOBY	1	4- 7	2
	SUBTOTAL	4567	-	17910
	TOTAL	6662	-	29254

APPENDIX TABLE 13

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
22-23 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	17	8-11	27
	GIZZARD SHAD	15	12-15	470
	GIZZARD SHAD	4	24-27	1251
	GIZZARD SHAD	1	25-28	359
	THREADFIN SHAD	96	4- 7	264
	THREADFIN SHAD	1	8-11	25
	BAY ANCHOVY	2	4- 7	10
	LAKE CHUBSUCKER	1	4- 7	10
	WHITE CATFISH	1	8-11	28
	WHITE CATFISH	1	12-15	77
	WHITE CATFISH	3	16-19	395
	YELLOW BULLHEAD	1	8-11	10
	CHANNEL CATFISH	3	4- 7	21
	CHANNEL CATFISH	5	8-11	67
	CHANNEL CATFISH	1	12-15	53
	TADPOLE MADTOM	4	4- 7	32
	TADPOLE MADTOM	1	8-11	9
	BLUEGILL	152	0- 3	217
	BLUEGILL	1017	4- 7	3472
	BLUEGILL	1	8-11	31
	REDEAR SUNFISH	7	0- 3	9
	REDEAR SUNFISH	28	4- 7	110
	REDEAR SUNFISH	1	8-11	4
	BLACK CRAPPIE	10	4- 7	130
	BLACK CRAPPIE	66	8-11	1598
	BLACK CRAPPIE	4	12-15	302
	BLACK CRAPPIE	1	16-19	175
	CLOWN GOBY	2	4- 7	2
	SUBTOTAL	1446	-	9158
1900-0700	GIZZARD SHAD	46	8-11	880

APPENDIX TABLE 13
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
22-23 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	GIZZARD SHAD	15	12-15	548
	GIZZARD SHAD	2	16-19	214
	GIZZARD SHAD	10	24-27	2607
	THREADFIN SHAD	316	4- 7	810
	THREADFIN SHAD	15	8-11	196
	BAY ANCHOVY	10	4- 7	42
	BAY ANCHOVY	1	8-11	4
	WHITE CATFISH	1	8-11	29
	WHITE CATFISH	2	12-15	98
	CHANNEL CATFISH	4	8-11	25
	CHANNEL CATFISH	1	12-15	20
	TADPOLE MADTOM	6	4- 7	40
	BLUEGILL	204	0- 3	357
	BLUEGILL	1032	4- 7	3231
	BLUEGILL	3	8-11	54
	REDEAR SUNFISH	2	0- 3	2
	REDEAR SUNFISH	51	4- 7	174
	REDEAR SUNFISH	3	8-11	76
	BLACK CRAPPIE	6	4- 7	53
	BLACK CRAPPIE	35	8-11	889
	BLACK CRAPPIE	8	12-15	441
	BLACK CRAPPIE	1	16-19	151
	BLACK CRAPPIE	1	24-27	442
	CLOWN GOBY	2	4- 7	2
	SUBTOTAL	1777	-	11383
	TOTAL	3223	-	20541

APPENDIX TABLE 14

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
27-28 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	12	8-11	240
	GIZZARD SHAD	11	12-15	354
	GIZZARD SHAD	1	20-23	205
	GIZZARD SHAD	4	24-27	1164
	GIZZARD SHAD	1	25-28	410
	THREADFIN SHAD	93	4- 7	240
	THREADFIN SHAD	5	8-11	72
	WHITE CATFISH	3	12-15	204
	CHANNEL CATFISH	14	4- 7	64
	CHANNEL CATFISH	8	8-11	98
	CHANNEL CATFISH	1	12-15	52
	CHANNEL CATFISH	1	16-19	136
	TADPOLE MADTOM	7	4- 7	48
	SEMINOLE KILLIFISH	1	8-11	13
	TIDEWATER SILVERSIDE	1	4- 7	3
	BLUEGILL	283	0- 3	391
	BLUEGILL	1278	4- 7	4605
	BLUEGILL	1	8-11	4
	BLUEGILL	1	12-15	125
	BLUEGILL	1	16-19	126
	REDEAR SUNFISH	21	4- 7	97
	REDEAR SUNFISH	1	16-19	225
	LARGEMOUTH BASS	1	8-11	30
	BLACK CRAPPIE	1	4- 7	13
	BLACK CRAPPIE	48	8-11	1246
	BLACK CRAPPIE	17	12-15	476
	SUBTOTAL	1813	-	10640
1900-0700	GIZZARD SHAD	11	8-11	229
	GIZZARD SHAD	15	12-15	616
	GIZZARD SHAD	5	24-27	1301

APPENDIX TABLE 14
(CONTINUED)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
27-28 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
1900-0700	THREADFIN SHAD	396	4- 7	923
	THREADFIN SHAD	11	8-11	198
	BAY ANCHOVY	4	4- 7	22
	WHITE CATFISH	1	12-15	62
	CHANNEL CATFISH	2	4- 7	7
	CHANNEL CATFISH	9	8-11	140
	CHANNEL CATFISH	1	12-15	25
	TADPOLE MADTOM	4	4- 7	27
	ATLANTIC NEEDLEFISH	1	16-19	9
	ATLANTIC NEEDLEFISH	1	25-28	112
	SEMINOLE KILLIFISH	1	8-11	14
	BLUEGILL	520	0- 3	759
	BLUEGILL	1437	4- 7	6146
	BLUEGILL	1	8-11	5
	BLUEGILL	1	12-15	79
	REDEAR SUNFISH	2	0- 3	2
	REDEAR SUNFISH	34	4- 7	143
	REDEAR SUNFISH	1	8-11	21
	BLACK CRAPPIE	1	4- 7	5
	BLACK CRAPPIE	39	8-11	1066
	BLACK CRAPPIE	6	12-15	417
	BLACK CRAPPIE	1	16-19	220
	BLACK CRAPPIE	1	20-23	233
	NAKED GOBY	1	0- 3	1
	SUBTOTAL	2507	-	12779
	TOTAL	4320	-	23419

APPENDIX TABLE 15

RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE MARTIN PLANT
29-30 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	GIZZARD SHAD	12	8-11	256
	GIZZARD SHAD	16	12-15	590
	GIZZARD SHAD	3	16-19	191
	GIZZARD SHAD	1	20-23	173
	GIZZARD SHAD	6	24-27	1476
	GIZZARD SHAD	2	25-28	688
	THREADFIN SHAD	1	0- 3	1
	THREADFIN SHAD	74	4- 7	200
	THREADFIN SHAD	7	8-11	110
	BAY ANCHOVY	4	4- 7	17
	WHITE CATFISH	2	8-11	23
	WHITE CATFISH	1	12-15	80
	WHITE CATFISH	3	16-19	335
	CHANNEL CATFISH	16	4- 7	62
	CHANNEL CATFISH	7	8-11	77
	CHANNEL CATFISH	3	12-15	87
	CHANNEL CATFISH	1	16-19	84
	TADPOLE MADTOM	5	4- 7	34
	TIDEWATER SILVERSIDE	1	4- 7	2
	BLUEGILL	322	0- 3	460
	BLUEGILL	1339	4- 7	6016
	BLUEGILL	3	8-11	102
	BLUEGILL	1	12-15	119
	BLUEGILL	1	16-19	120
	REDEAR SUNFISH	3	0- 3	5
	REDEAR SUNFISH	27	4- 7	101
	REDEAR SUNFISH	2	8-11	45
	REDEAR SUNFISH	1	12-15	87
	BLACK CRAPPIE	2	4- 7	24
	BLACK CRAPPIE	57	8-11	1405
	BLACK CRAPPIE	10	12-15	690
	BLACK CRAPPIE	1	16-19	141

APPENDIX TABLE 15
(continued)
RESULTS OF 24-HOUR IMPINGEMENT SAMPLING AT THE
MARTIN PLANT
29-30 MARCH 1978

TIME	SPECIES	NUMBER OF INDIVIDUALS	RANGE OF TOTAL LENGTHS (MM)	TOTAL WEIGHT (G)
0700-1900	BLACK CRAPPIE	1	20-23	220
	SUBTOTAL	1935	-	14020
1900-0700	THREADFIN SHAD	193	4- 7	450
	THREADFIN SHAD	6	8-11	62
	GIZZARD SHAD	18	8-11	378
	GIZZARD SHAD	5	12-15	200
	GIZZARD SHAD	2	16-19	165
	GIZZARD SHAD	2	20-23	309
	GIZZARD SHAD	5	24-27	1436
	GIZZARD SHAD	5	25-28	1743
	BAY ANCHOVY	7	4- 7	25
	WHITE CATFISH	3	4- 7	18
	WHITE CATFISH	1	8-11	25
	WHITE CATFISH	2	12-15	98
	WHITE CATFISH	5	16-19	590
	CHANNEL CATFISH	10	4- 7	55
	CHANNEL CATFISH	9	8-11	144
	TADPOLE MADTOM	3	4- 7	23
	BLUEGILL	256	0- 3	418
	BLUEGILL	860	4- 7	3703
	BLUEGILL	2	8-11	59
	BLUEGILL	2	16-19	354
	REDEAR SUNFISH	5	0- 3	7
	REDEAR SUNFISH	22	4- 7	81
	BLACK CRAPPIE	2	4- 7	23
	BLACK CRAPPIE	39	8-11	1077
	BLACK CRAPPIE	11	12-15	692
	BLACK CRAPPIE	2	16-19	394
	SUBTOTAL	1477	-	12530
	TOTAL	3412	-	26550

APPENDIX TABLE 16

ANALYSIS OF VARIANCE:
COMPARISON OF THE NUMBER OF FISH IMPINGED BY DIEL PERIOD
MARTIN PLANT
6 FEBRUARY - 30 MARCH 1978

Source	DF	Sum of squares	Mean square
Model	1	0.055	0.055
Error	27	11.773	0.436
Corrected Total	28	11.829	-

Source	DF	Sum of squares[a]	F value	PR > F
Period	1	0.055	0.13	0.722

APPENDIX TABLE 17

ANALYSIS OF VARIANCE:
COMPARISON OF THE BIOMASS OF FISH IMPINGED BY DIEL PERIOD
MARTIN PLANT
6 FEBRUARY - 30 MARCH 1978

Source	DF	Sum of squares	Mean square
Model	1	0.057	0.057
Error	27	5.062	0.187
Corrected Total	28	5.119	-

Source	DF	Sum of squares[a]	F value	PR > F
Period	1	0.057	0.30	0.585

[a]Type I Sum of squares following the procedures of Barr et al. (1976).

APPENDIX TABLE 18

DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/ 7	1	B	D	TIDEWATER SILVERSIDE	10.9	10.9	1	0.016
2/ 7	2	B	D	TIDEWATER SILVERSIDE	10.9	11.0	2	0.031
2/ 7	3	B	D	TIDEWATER SILVERSIDE	4.8	4.8	1	0.017
2/ 7	1	B	D	BLACK CRAPPIE	4.6	4.6	1	0.016
2/ 7	2	B	D	BLACK CRAPPIE	4.2	4.5	4	0.062
2/ 7	3	B	D	BLACK CRAPPIE	5.0	5.1	5	0.086
2/ 7	4	B	D	BLACK CRAPPIE	4.6	5.1	10	0.177
2/ 7	4	B	D	NAKED GOBY	13.6	13.6	1	0.018
2/ 7	1	B	D	CLOWN GOBY	11.2	11.2	1	0.016
2/ 7	3	B	D	CLOWN GOBY	11.5	18.4	2	0.034
2/ 7	1	B	N	TIDEWATER SILVERSIDE	5.3	11.0	5	0.085
2/ 7	2	B	N	TIDEWATER SILVERSIDE	9.1	9.1	2	0.034
2/ 7	3	B	N	TIDEWATER SILVERSIDE	7.7	11.2	4	0.068
2/ 7	4	B	N	TIDEWATER SILVERSIDE	7.8	12.2	11	0.187
2/ 7	1	B	N	BLACK CRAPPIE	4.9	5.1	2	0.034
2/ 7	3	B	N	BLACK CRAPPIE	4.8	5.1	11	0.188
2/ 7	4	B	N	BLACK CRAPPIE	4.3	4.9	27	0.458
2/ 7	1	S	D	HERRINGS	5.0	6.0	2	0.038
2/ 7	1	S	D	TIDEWATER SILVERSIDE	9.3	10.9	2	0.038
2/ 7	2	S	D	TIDEWATER SILVERSIDE	10.7	10.7	1	0.018

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/ 9	2	B	D	BLACK CRAPPIE	4.8	4.8	1	0.020
2/ 9	3	B	D	BLACK CRAPPIE	4.6	5.0	3	0.058
2/ 9	4	B	D	BLACK CRAPPIE	4.4	5.0	2	0.043
2/ 9	2	B	N	HERRINGS	33.6	33.6	1	0.019
2/ 9	3	B	N	TIDEWATER SILVERSIDE	10.9	10.9	1	0.019
2/ 9	4	B	N	TIDEWATER SILVERSIDE	11.4	11.4	1	0.018
2/ 9	1	B	N	BLACK CRAPPIE	5.1	5.1	1	0.017
2/ 9	3	B	N	BLACK CRAPPIE	4.5	4.8	25	0.464
2/ 9	4	B	N	BLACK CRAPPIE	4.5	5.1	22	0.387
2/ 9	2	S	D	HERRINGS	5.6	5.6	1	0.018
2/ 9	3	S	D	HERRINGS	.	.	1	0.020
2/ 9	4	S	D	HERRINGS	5.6	5.6	1	0.019
2/ 9	3	S	D	TIDEWATER SILVERSIDE	.	.	1	0.020
2/ 9	2	S	D	SUNFISHES	4.3	4.3	1	0.018
2/ 9	1	S	D	BLACK CRAPPIE	4.5	5.0	6	0.114
2/ 9	2	S	D	BLACK CRAPPIE	4.6	5.0	7	0.129
2/ 9	3	S	D	BLACK CRAPPIE	.	.	3	0.060
2/ 9	4	S	D	BLACK CRAPPIE	4.6	5.1	38	0.737
2/ 9	2	S	N		22.4	22.4	1	0.019

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)

DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/ 7	3	S	D	TIDEWATER SILVERSIDE	8.0	11.5	3	0.051
2/ 7	4	S	D	TIDEWATER SILVERSIDE	9.1	10.2	4	0.074
2/ 7	1	S	D	BLACK CRAPPIE	4.6	4.6	1	0.019
2/ 7	2	S	D	BLACK CRAPPIE	4.6	5.0	3	0.054
2/ 7	3	S	D	BLACK CRAPPIE	4.5	4.6	12	0.204
2/ 7	4	S	D	BLACK CRAPPIE	4.6	5.1	8	0.148
2/ 7	1	S	D	CLOWN GOBY	11.0	11.0	1	0.019
2/ 7	1	S	N	TIDEWATER SILVERSIDE	12.0	13.0	2	0.045
2/ 7	2	S	N	TIDEWATER SILVERSIDE	11.0	12.2	3	0.048
2/ 7	3	S	N	TIDEWATER SILVERSIDE	5.3	10.9	6	0.100
2/ 7	4	S	N	TIDEWATER SILVERSIDE	11.4	11.4	1	0.022
2/ 7	1	S	N	BLACK CRAPPIE	5.0	5.1	3	0.068
2/ 7	2	S	N	BLACK CRAPPIE	4.5	4.8	4	0.064
2/ 7	3	S	N	BLACK CRAPPIE	4.3	4.6	7	0.116
2/ 7	4	S	N	BLACK CRAPPIE	4.8	5.0	10	0.218
2/ 7	4	S	N	CLOWN GOBY	13.6	13.6	1	0.022
2/ 9	1	B	D		.	.	0	0.000
2/ 9	3	B	D	TIDEWATER SILVERSIDE	16.5	16.5	1	0.019
2/ 9	4	B	D	TIDEWATER SILVERSIDE	12.8	12.8	1	0.021

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/ 9	1	S	N	TIDEWATER SILVERSIDE	10.2	18.1	4	0.080
2/ 9	2	S	N	TIDEWATER SILVERSIDE	10.1	17.6	4	0.074
2/ 9	3	S	N	TIDEWATER SILVERSIDE	12.0	28.6	6	0.111
2/ 9	4	S	N	TIDEWATER SILVERSIDE	10.4	23.0	3	0.056
2/ 9	2	S	N	SUNFISHES	29.0	29.0	1	0.019
2/ 9	1	S	N	BLACK CRAPPIE	5.3	5.3	2	0.040
2/ 9	3	S	N	BLACK CRAPPIE	4.3	4.6	15	0.278
2/ 9	4	S	N	BLACK CRAPPIE	4.6	5.0	23	0.432
2/ 9	2	S	N	NAKED GOBY	22.1	22.1	1	0.209
2/14	1	B	D		.	.	0	0.000
2/14	2	B	D		.	.	0	0.000
2/14	3	B	D		.	.	0	0.000
2/14	4	B	D		.	.	0	0.000
2/14	2	B	N	HERRINGS	4.8	5.1	3	0.063
2/14	1	B	N	TIDEWATER SILVERSIDE	10.1	11.2	2	0.045
2/14	2	B	N	TIDEWATER SILVERSIDE	10.3	10.8	2	0.042
2/14	3	B	N	TIDEWATER SILVERSIDE	11.0	13.0	10	0.189
2/14	3	B	N	BLACK CRAPPIE	5.1	5.1	1	0.019
2/14	2	S	D		.	.	0	0.000

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/14	3	S	D		.	.	0	0.000
2/14	1	S	D	TIDEWATER SILVERSIDE	7.5	12.5	15	0.226
2/14	4	S	D	TIDEWATER SILVERSIDE	11.7	11.7	1	0.019
2/14	4	S	D	BLACK CRAPPIE	4.8	4.8	1	0.019
2/14	2	S	N	HERRINGS	6.0	6.0	1	0.021
2/14	3	S	N	GOLDEN SHINER	6.5	6.5	1	0.021
2/14	1	S	N	TIDEWATER SILVERSIDE	13.4	22.4	9	0.154
2/14	2	S	N	TIDEWATER SILVERSIDE	16.5	16.5	1	0.021
2/14	3	S	N	TIDEWATER SILVERSIDE	9.6	13.9	5	0.105
2/15	4	B	N	GOLDEN SHINER	6.9	6.9	1	0.020
2/15	4	B	N	TIDEWATER SILVERSIDE	11.5	12.3	4	0.082
2/15	4	B	N	BLACK CRAPPIE	4.8	4.8	1	0.020
2/15	4	S	N	TIDEWATER SILVERSIDE	11.0	14.4	4	0.073
2/16	1	B	D	TIDEWATER SILVERSIDE	13.6	13.6	1	0.015
2/16	2	B	D	TIDEWATER SILVERSIDE	11.7	11.7	1	0.014
2/16	3	B	D	BLACK CRAPPIE	4.8	5.3	3	0.041
2/16	4	B	D	BLACK CRAPPIE	5.0	5.0	1	0.012
2/16	4	B	N		.	.	0	0.000
2/16	3	B	N	GOLDEN SHINER	6.2	6.2	1	0.016

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/16	1	B	N	TIDEWATER SILVERSIDE	11.2	16.3	2	0.038
2/16	2	B	N	TIDEWATER SILVERSIDE	11.5	11.8	2	0.028
2/16	2	B	N	BLACK CRAPPIE	5.6	5.6	1	0.014
2/16	3	B	N	BLACK CRAPPIE	4.6	5.0	8	0.127
2/16	3	B	N	PERCHES	4.6	4.6	1	0.016
2/16	2	S	D		.	.	0	0.000
2/16	4	S	D	HERRINGS	5.9	5.9	1	0.013
2/16	1	S	D	TIDEWATER SILVERSIDE	9.6	12.8	2	0.026
2/16	3	S	D	TIDEWATER SILVERSIDE	12.0	12.0	1	0.020
2/16	4	S	D	TIDEWATER SILVERSIDE	11.0	11.0	1	0.013
2/16	3	S	D	BLACK CRAPPIE	4.8	5.1	10	0.204
2/16	4	S	D	BLACK CRAPPIE	5.0	5.0	3	0.038
2/16	1	S	N	HERRINGS	6.1	6.1	1	0.015
2/16	3	S	N	HERRINGS	6.2	6.2	1	0.019
2/16	3	S	N	SUCKERS	7.2	7.2	1	0.019
2/16	3	S	N	GOLDEN SHINER	6.4	6.7	2	0.037
2/16	4	S	N	GOLDEN SHINER	6.2	6.5	6	0.108
2/16	1	S	N	TIDEWATER SILVERSIDE	10.0	10.0	1	0.015
2/16	2	S	N	TIDEWATER SILVERSIDE	11.0	16.8	5	0.080

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/16	4	S	N	TIDEWATER SILVERSIDE	9.6	10.4	3	0.054
2/16	3	S	N	SUNFISHES	5.1	5.1	1	0.019
2/16	3	S	N	BLACK CRAPPIE	4.6	4.9	5	0.093
2/16	4	S	N	BLACK CRAPPIE	4.6	5.0	4	0.072
2/16	4	S	N	PERCHES	4.5	4.5	1	0.018
2/21	1	B	D		.	.	0	0.000
2/21	2	B	D		.	.	0	0.000
2/21	3	B	D		.	.	0	0.000
2/21	4	B	D	HERRINGS	4.6	5.8	138	2.121
2/21	4	B	D	TIDEWATER SILVERSIDE	4.8	9.4	2	0.031
2/21	1	B	N	HERRINGS	4.8	5.9	23	0.342
2/21	2	B	N	HERRINGS	5.8	6.2	27	0.518
2/21	3	B	N	HERRINGS	4.4	6.1	38	0.685
2/21	4	B	N	HERRINGS	4.9	5.5	55	0.926
2/21	4	B	N	GOLDEN SHINER	6.3	6.3	1	0.017
2/21	1	B	N	TIDEWATER SILVERSIDE	5.0	5.4	3	0.045
2/21	2	B	N	TIDEWATER SILVERSIDE	5.0	5.0	1	0.019
2/21	3	B	N	TIDEWATER SILVERSIDE	4.8	4.8	1	0.018
2/21	4	B	N	TIDEWATER SILVERSIDE	4.5	4.6	3	0.051

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/21	3	B	N	SUNFISHES	4.4	4.4	1	0.018
2/21	2	S	D		.	.	0	0.000
2/21	3	S	D		.	.	0	0.000
2/21	1	S	D	HERRINGS	5.6	6.4	2	0.032
2/21	4	S	D	HERRINGS	5.0	5.7	102	1.791
2/21	1	S	N	HERRINGS	4.8	6.4	21	0.334
2/21	2	S	N	HERRINGS	5.0	5.9	28	0.453
2/21	3	S	N	HERRINGS	5.3	6.1	30	0.486
2/21	4	S	N	HERRINGS	5.2	5.8	17	0.318
2/21	1	S	N	TIDEWATER SILVERSIDE	4.5	21.0	6	0.095
2/21	2	S	N	TIDEWATER SILVERSIDE	4.8	15.0	3	0.049
2/21	3	S	N	TIDEWATER SILVERSIDE	11.4	11.4	1	0.016
2/21	4	S	N	TIDEWATER SILVERSIDE	4.5	10.9	3	0.056
2/23	1	B	D	HERRINGS	5.5	5.5	1	0.017
2/23	3	B	D	HERRINGS	4.6	6.0	2	0.050
2/23	4	B	D	HERRINGS	4.5	4.5	2	0.034
2/23	2	B	D	TIDEWATER SILVERSIDE	4.8	13.2	3	0.038
2/23	3	B	D	TIDEWATER SILVERSIDE	4.1	4.1	1	0.025
2/23	4	B	D	TIDEWATER SILVERSIDE	4.5	4.9	2	0.034

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/23	3	B	D	BLACK CRAPPIE	4.5	4.5	1	0.025
2/23	1	B	N	HERRINGS	5.4	5.5	5	0.077
2/23	2	B	N	HERRINGS	4.5	4.5	2	0.028
2/23	1	B	N	TIDEWATER SILVERSIDE	4.5	4.8	4	0.062
2/23	2	B	N	TIDEWATER SILVERSIDE	4.5	4.6	3	0.043
2/23	1	B	N	SUNFISHES	4.6	4.6	1	0.015
2/23	1	B	N	BLACK CRAPPIE	4.6	4.6	1	0.015
2/23	1	S	D	HERRINGS	5.5	5.5	1	0.017
2/23	2	S	D	HERRINGS	5.5	5.8	3	0.037
2/23	3	S	D	HERRINGS	5.2	5.2	1	0.019
2/23	4	S	D	HERRINGS	5.4	5.7	4	0.092
2/23	1	S	D	TIDEWATER SILVERSIDE	4.2	11.7	17	0.285
2/23	2	S	D	TIDEWATER SILVERSIDE	9.1	10.9	3	0.037
2/23	2	S	D	BLACK CRAPPIE	4.8	4.9	2	0.025
2/23	4	S	D	BLACK CRAPPIE	4.3	4.3	1	0.023
2/23	1	S	N	HERRINGS	5.1	5.7	3	0.051
2/23	2	S	N	HERRINGS	5.5	5.8	3	0.048
2/23	1	S	N	TIDEWATER SILVERSIDE	4.8	14.8	5	0.086
2/23	2	S	N	TIDEWATER SILVERSIDE	4.6	4.6	1	0.016

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
2/24	3	B	N	HERRINGS	6.0	6.0	2	0.046
2/24	4	B	N	HERRINGS	3.7	5.2	2	0.032
2/24	4	B	N	GOLDEN SHINER	5.8	5.8	1	0.016
2/24	3	B	N	TIDEWATER SILVERSIDE	4.5	9.9	5	0.115
2/24	4	B	N	TIDEWATER SILVERSIDE	10.3	10.3	1	0.016
2/24	4	B	N	BLACK CRAPPIE	4.2	4.3	2	0.032
2/24	4	B	N	PERCHES	5.0	5.0	1	0.016
2/24	3	S	N	HERRINGS	4.5	5.7	4	0.076
2/24	4	S	N	HERRINGS	5.2	5.7	5	0.070
2/24	3	S	N	GOLDEN SHINER	5.4	5.4	1	0.019
2/24	4	S	N	GOLDEN SHINER	4.8	6.0	6	0.084
2/24	3	S	N	TIDEWATER SILVERSIDE	4.5	11.1	3	0.057
2/24	4	S	N	TIDEWATER SILVERSIDE	4.6	9.3	8	0.112
2/24	3	S	N	SUNFISHES	4.0	4.0	2	0.038
3/ 2	1	B	D	HERRINGS	4.9	6.0	5	0.076
3/ 2	2	B	D	HERRINGS	4.9	5.1	3	0.047
3/ 2	4	B	D	HERRINGS	5.4	5.5	2	0.030
3/ 2	2	B	D	BLACK CRAPPIE	4.6	4.9	7	0.109
3/ 2	3	B	D	BLACK CRAPPIE	4.8	5.1	9	0.161

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/ 2	4	B	D	BLACK CRAPPIE	4.6	5.2	6	0.089
3/ 2	4	B	D	PERCHES	4.1	4.1	1	0.015
3/ 2	1	B	N	HERRINGS	5.2	5.4	2	0.038
3/ 2	3	B	N	HERRINGS	4.9	6.1	2	0.033
3/ 2	4	B	N	HERRINGS	4.2	6.0	2	0.043
3/ 2	1	B	N	TIDEWATER SILVERSIDE	5.5	5.5	1	0.019
3/ 2	2	B	N	TIDEWATER SILVERSIDE	4.8	8.9	3	0.041
3/ 2	3	B	N	TIDEWATER SILVERSIDE	4.5	4.6	2	0.030
3/ 2	4	B	N	TIDEWATER SILVERSIDE	3.9	11.1	5	0.108
3/ 2	1	B	N	BLACK CRAPPIE	4.8	4.8	1	0.019
3/ 2	2	B	N	BLACK CRAPPIE	4.4	4.9	2	0.027
3/ 2	3	B	N	BLACK CRAPPIE	4.2	4.8	11	0.164
3/ 2	4	B	N	BLACK CRAPPIE	4.5	4.6	4	0.086
3/ 2	2	B	N	PERCHES	8.8	8.8	1	0.014
3/ 2	1	S	D	HERRINGS	4.9	6.3	5	0.071
3/ 2	2	S	D	HERRINGS	6.0	6.0	1	0.019
3/ 2	3	S	D	HERRINGS	5.7	6.0	4	0.071
3/ 2	4	S	D	HERRINGS	4.9	5.2	2	0.032
3/ 2	1	S	D	TIDEWATER SILVERSIDE	4.6	10.9	11	0.155

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/ 2	3	S	D	TIDEWATER SILVERSIDE	5.8	5.8	1	0.018
3/ 2	1	S	D	BLACK CRAPPIE	4.6	4.9	5	0.071
3/ 2	3	S	D	BLACK CRAPPIE	4.5	5.1	7	0.124
3/ 2	4	S	D	BLACK CRAPPIE	4.8	5.2	6	0.096
3/ 2	2	S	D	PERCHES	4.8	4.8	1	0.019
3/ 2	4	S	D	PERCHES	4.2	4.2	1	0.016
3/ 2	1	S	N	HERRINGS	5.4	5.4	1	0.018
3/ 2	3	S	N	HERRINGS	5.1	5.2	2	0.035
3/ 2	4	S	N	HERRINGS	4.2	4.6	2	0.037
3/ 2	1	S	N	TIDEWATER SILVERSIDE	5.4	5.7	2	0.037
3/ 2	2	S	N	TIDEWATER SILVERSIDE	4.7	14.0	3	0.052
3/ 2	3	S	N	TIDEWATER SILVERSIDE	4.6	9.7	4	0.070
3/ 2	4	S	N	TIDEWATER SILVERSIDE	5.8	10.2	3	0.055
3/ 2	1	S	N	BLACK CRAPPIE	4.2	4.3	5	0.092
3/ 2	2	S	N	BLACK CRAPPIE	4.8	4.8	1	0.017
3/ 2	3	S	N	BLACK CRAPPIE	4.2	4.6	23	0.404
3/ 2	4	S	N	BLACK CRAPPIE	4.1	4.9	18	0.329
3/ 7	1	B	D	HERRINGS	5.2	6.1	239	3.953
3/ 7	2	B	D	HERRINGS	5.2	5.7	755	13.771

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**
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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/ 7	3	B	D	HERRINGS	4.8	5.8	364	8.141
3/ 7	4	B	D	HERRINGS	5.7	6.0	544	14.006
3/ 7	3	B	D	TIDEWATER SILVERSIDE	5.1	5.1	1	0.022
3/ 7	1	B	D	BLACK CRAPPIE	5.8	6.0	2	0.033
3/ 7	4	B	D	PERCHES	4.5	4.5	1	0.026
3/ 7	3	B	N	HERRINGS	5.4	6.0	800	16.727
3/ 7	4	B	N	HERRINGS	5.5	6.3	943	21.362
3/ 7	3	B	N	GOLDEN SHINER	6.1	6.1	1	0.021
3/ 7	3	B	N	TIDEWATER SILVERSIDE	4.8	5.4	2	0.042
3/ 7	4	B	N	TIDEWATER SILVERSIDE	4.6	5.7	4	0.091
3/ 7	3	B	N	BLACK CRAPPIE	4.3	4.6	3	0.063
3/ 7	4	B	N	BLACK CRAPPIE	4.5	4.5	2	0.045
3/ 7	1	S	D	HERRINGS	4.0	6.7	17	0.293
3/ 7	2	S	D	HERRINGS	5.1	6.1	77	1.293
3/ 7	3	S	D	HERRINGS	4.8	5.5	197	3.992
3/ 7	4	S	D	HERRINGS	4.8	6.4	601	12.256
3/ 7	2	S	D	TIDEWATER SILVERSIDE	3.9	5.2	2	0.034
3/ 7	1	S	D	BLACK CRAPPIE	6.3	6.3	1	0.017
3/ 7	3	S	D	BLACK CRAPPIE	5.7	5.7	1	0.020

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/ 7	2	S	N	HERRINGS	5.4	6.0	460	9.595
3/ 7	3	S	N	HERRINGS	4.5	6.0	805	12.729
3/ 7	4	S	N	HERRINGS	5.5	6.0	646	13.650
3/ 7	2	S	N	TIDEWATER SILVERSIDE	4.5	4.5	1	0.021
3/ 7	4	S	N	TIDEWATER SILVERSIDE	4.6	6.4	4	0.085
3/ 7	3	S	N	BLACK CRAPPIE	4.5	5.5	3	0.047
3/ 7	4	S	N	BLACK CRAPPIE	4.3	4.3	1	0.021
3/ 8	1	B	N	HERRINGS	5.1	6.6	630	13.285
3/ 8	2	B	N	HERRINGS	5.7	6.0	563	11.289
3/ 8	1	B	N	TIDEWATER SILVERSIDE	5.2	5.7	4	0.084
3/ 8	2	B	N	TIDEWATER SILVERSIDE	4.5	11.2	3	0.060
3/ 8	1	B	N	BLACK CRAPPIE	5.5	5.8	2	0.042
3/ 8	1	S	N	HERRINGS	5.2	5.8	573	11.862
3/ 9	1	B	D	HERRINGS	5.1	6.0	128	2.580
3/ 9	2	B	D	HERRINGS	5.5	6.1	360	7.040
3/ 9	3	B	D	HERRINGS	4.8	6.0	366	6.819
3/ 9	4	B	D	HERRINGS	4.8	6.3	193	3.987
3/ 9	2	B	D	BLACK CRAPPIE	4.3	5.8	11	0.215
3/ 9	3	B	D	BLACK CRAPPIE	4.2	6.1	66	1.230

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/ 9	4	B	D	BLACK CRAPPIE	3.9	5.8	36	0.744
3/ 9	1	B	D	PERCHES	3.8	3.8	1	0.020
3/ 9	1	B	N	HERRINGS	5.1	6.1	347	6.542
3/ 9	2	B	N	HERRINGS	5.7	6.1	229	3.928
3/ 9	3	B	N	HERRINGS	5.1	5.8	311	7.385
3/ 9	4	B	N	HERRINGS	5.2	6.3	290	5.811
3/ 9	3	B	N	GOLDEN SHINER	5.8	5.8	1	0.024
3/ 9	4	B	N	GOLDEN SHINER	5.8	5.8	1	0.020
3/ 9	4	B	N		8.1	8.1	1	0.020
3/ 9	1	B	N	TIDEWATER SILVERSIDE	4.5	4.9	2	0.038
3/ 9	2	B	N	TIDEWATER SILVERSIDE	4.3	4.3	1	0.017
3/ 9	3	B	N	TIDEWATER SILVERSIDE	4.9	5.1	2	0.047
3/ 9	4	B	N	TIDEWATER SILVERSIDE	5.5	5.5	1	0.020
3/ 9	1	B	N	BLACK CRAPPIE	4.6	6.7	14	0.264
3/ 9	2	B	N	BLACK CRAPPIE	4.5	4.6	9	0.154
3/ 9	3	B	N	BLACK CRAPPIE	3.9	4.9	54	1.282
3/ 9	4	B	N	BLACK CRAPPIE	4.3	4.6	235	4.709
3/ 9	4	B	N	PERCHES	6.6	6.6	1	0.020
3/ 9	1	S	D	HERRINGS	4.3	6.0	311	5.340

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/ 9	2	S	D	HERRINGS	5.1	6.1	482	7.270
3/ 9	3	S	D	HERRINGS	5.1	6.4	875	13.885
3/ 9	4	S	D	HERRINGS	5.2	6.3	396	7.069
3/ 9	1	S	D	TIDEWATER SILVERSIDE	4.8	5.1	2	0.034
3/ 9	2	S	D	TIDEWATER SILVERSIDE	4.8	4.8	1	0.015
3/ 9	1	S	D	BLACK CRAPPIE	4.2	5.7	8	0.137
3/ 9	2	S	D	BLACK CRAPPIE	4.3	7.6	6	0.091
3/ 9	3	S	D	BLACK CRAPPIE	4.6	6.7	17	0.270
3/ 9	4	S	D	BLACK CRAPPIE	4.8	5.4	25	0.446
3/ 9	2	S	D	PERCHES	4.6	5.7	2	0.030
3/ 9	3	S	D	PERCHES	4.3	5.2	5	0.079
3/ 9	1	S	N	HERRINGS	5.1	6.1	206	3.977
3/ 9	2	S	N	HERRINGS	4.3	5.8	244	4.884
3/ 9	3	S	N	HERRINGS	5.7	6.1	258	4.714
3/ 9	4	S	N	HERRINGS	5.2	6.3	242	4.373
3/ 9	3	S	N	GOLDEN SHINER	6.3	6.9	6	0.110
3/ 9	4	S	N	GOLDEN SHINER	5.7	6.1	7	0.126
3/ 9	2	S	N		21.3	21.3	1	0.020
3/ 9	2	S	N	TIDEWATER SILVERSIDE	4.9	4.9	1	0.020

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S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY – APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/ 9	4	S	N	TIDEWATER SILVERSIDE	.	.	1	0.018
3/ 9	1	S	N	BLACK CRAPPIE	4.2	6.7	7	0.135
3/ 9	2	S	N	BLACK CRAPPIE	4.3	4.5	28	0.560
3/ 9	3	S	N	BLACK CRAPPIE	4.2	4.6	102	1.864
3/ 9	4	S	N	BLACK CRAPPIE	4.2	4.6	233	4.210
3/ 9	2	S	N	PERCHES	4.2	5.5	2	0.040
3/ 9	3	S	N	PERCHES	3.2	3.9	3	0.055
3/ 9	4	S	N	PERCHES	3.7	3.7	1	0.018
3/ 9	4	S	N	UNIDENTIFIED LARVAE	4.3	4.3	1	0.018
3/14	1	B	D	HERRINGS	5.1	5.4	27	0.433
3/14	2	B	D	HERRINGS	4.9	5.4	30	0.489
3/14	3	B	D	HERRINGS	3.6	7.2	23	0.366
3/14	4	B	D	HERRINGS	5.2	6.0	33	0.514
3/14	2	B	D	TIDEWATER SILVERSIDE	4.6	5.4	2	0.033
3/14	3	B	D	TIDEWATER SILVERSIDE	4.5	4.5	1	0.016
3/14	4	B	D	TIDEWATER SILVERSIDE	16.8	16.8	1	0.016
3/14	1	B	D	BLACK CRAPPIE	4.2	4.6	2	0.032
3/14	2	B	D	BLACK CRAPPIE	4.5	4.5	1	0.016
3/14	3	B	D	BLACK CRAPPIE	4.5	4.9	5	0.080

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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/14	4	B	D	BLACK CRAPPIE	4.5	4.6	8	0.124
3/14	1	B	D	PERCHES	3.7	3.7	1	0.016
3/14	4	B	D	PERCHES	5.5	5.5	1	0.016
3/14	1	B	N	HERRINGS	4.2	6.6	115	2.002
3/14	3	B	N	HERRINGS	4.6	6.4	18	0.320
3/14	4	B	N	HERRINGS	4.8	5.8	39	0.676
3/14	1	B	N	TIDEWATER SILVERSIDE	4.3	4.8	9	0.157
3/14	3	B	N	TIDEWATER SILVERSIDE	4.6	4.9	4	0.071
3/14	4	B	N	TIDEWATER SILVERSIDE	4.5	4.8	5	0.087
3/14	1	B	N	BLACK CRAPPIE	4.3	4.6	2	0.035
3/14	4	B	N	BLACK CRAPPIE	4.3	4.5	4	0.069
3/14	1	S	D	HERRINGS	4.9	7.3	26	0.429
3/14	2	S	D	HERRINGS	5.1	5.7	21	0.346
3/14	3	S	D	HERRINGS	5.2	7.5	15	0.232
3/14	4	S	D	HERRINGS	5.8	6.0	12	0.194
3/14	3	S	D	TIDEWATER SILVERSIDE	4.9	5.8	2	0.031
3/14	4	S	D	TIDEWATER SILVERSIDE	3.9	4.6	2	0.032
3/14	3	S	D	SUNFISHES	4.1	4.1	1	0.015
3/14	1	S	D	BLACK CRAPPIE	4.6	5.2	4	0.066

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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/14	2	S	D	BLACK CRAPPIE	4.6	4.8	2	0.033
3/14	3	S	D	BLACK CRAPPIE	4.5	4.8	3	0.046
3/14	4	S	D	BLACK CRAPPIE	4.2	5.4	3	0.048
3/14	2	S	D	PERCHES	4.2	6.9	7	0.115
3/14	1	S	N	HERRINGS	5.4	6.7	98	1.573
3/14	3	S	N	HERRINGS	5.1	6.4	10	0.188
3/14	4	S	N	HERRINGS	4.9	7.6	27	0.421
3/14	1	S	N	TIDEWATER SILVERSIDE	4.5	4.8	11	0.177
3/14	3	S	N	TIDEWATER SILVERSIDE	4.2	4.9	5	0.094
3/14	4	S	N	TIDEWATER SILVERSIDE	4.8	5.4	3	0.047
3/14	4	S	N	BLACK CRAPPIE	4.2	5.2	9	0.140
3/14	3	S	N	PERCHES	4.6	4.6	1	0.019
3/15	2	B	N	HERRINGS	4.9	6.7	76	1.265
3/15	2	B	N	TIDEWATER SILVERSIDE	5.1	5.1	1	0.017
3/15	2	S	N	HERRINGS	4.6	6.4	23	0.513
3/15	2	S	N	TIDEWATER SILVERSIDE	4.5	4.8	7	0.156
3/16	1	B	D	HERRINGS	3.7	6.0	22	0.456
3/16	2	B	D	HERRINGS	3.9	7.8	48	0.924
3/16	3	B	D	HERRINGS	5.2	6.7	29	0.469

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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/16	4	B	D	HERRINGS	4.3	8.2	44	0.680
3/16	1	B	D	BLACK CRAPPIE	4.3	4.6	2	0.041
3/16	3	B	D	BLACK CRAPPIE	4.3	4.4	4	0.065
3/16	4	B	D	BLACK CRAPPIE	4.1	4.6	9	0.139
3/16	1	B	N	HERRINGS	4.6	9.1	233	3.719
3/16	2	B	N	HERRINGS	4.2	7.9	212	3.493
3/16	3	B	N	HERRINGS	5.2	8.8	46	0.768
3/16	4	B	N	HERRINGS	4.3	7.9	38	0.696
3/16	4	B	N	SHINERS	8.7	13.0	2	0.037
3/16	1	B	N	TIDEWATER SILVERSIDE	4.6	5.2	3	0.048
3/16	2	B	N	TIDEWATER SILVERSIDE	5.2	6.6	6	0.099
3/16	3	B	N	TIDEWATER SILVERSIDE	4.8	5.1	6	0.100
3/16	4	B	N	TIDEWATER SILVERSIDE	4.8	6.1	4	0.073
3/16	1	B	N	BLACK CRAPPIE	3.9	4.3	10	0.160
3/16	2	B	N	BLACK CRAPPIE	4.2	4.5	5	0.082
3/16	3	B	N	BLACK CRAPPIE	4.2	4.5	2	0.033
3/16	4	B	N	BLACK CRAPPIE	4.3	4.5	73	1.338
3/16	1	S	D	HERRINGS	4.2	7.5	43	0.916
3/16	2	S	D	HERRINGS	5.1	5.7	83	1.456

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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
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DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/16	3	S	D	HERRINGS	4.3	7.5	57	0.901
3/16	4	S	D	HERRINGS	4.6	7.3	25	0.446
3/16	1	S	D	TIDEWATER SILVERSIDE	4.8	4.8	1	0.021
3/16	2	S	D	TIDEWATER SILVERSIDE	4.9	5.7	2	0.035
3/16	3	S	D	TIDEWATER SILVERSIDE	5.8	5.8	1	0.016
3/16	1	S	D	BLACK CRAPPIE	4.6	4.8	3	0.064
3/16	2	S	D	BLACK CRAPPIE	4.2	4.2	1	0.018
3/16	3	S	D	BLACK CRAPPIE	4.2	4.5	4	0.063
3/16	1	S	N	HERRINGS	4.9	8.7	268	5.077
3/16	2	S	N	HERRINGS	4.6	8.2	174	3.472
3/16	3	S	N	HERRINGS	5.4	9.1	105	1.470
3/16	4	S	N	HERRINGS	4.9	9.4	129	2.070
3/16	3	S	N	GOLDEN SHINER	6.9	6.9	1	0.014
3/16	1	S	N	TIDEWATER SILVERSIDE	4.6	5.2	3	0.057
3/16	2	S	N	TIDEWATER SILVERSIDE	4.6	6.3	16	0.319
3/16	3	S	N	TIDEWATER SILVERSIDE	5.1	6.0	9	0.126
3/16	4	S	N	TIDEWATER SILVERSIDE	4.2	8.4	18	0.289
3/16	1	S	N	BLACK CRAPPIE	4.2	4.3	5	0.095
3/16	2	S	N	BLACK CRAPPIE	4.2	5.5	3	0.060

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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
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MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/16	3	S	N	BLACK CRAPPIE	4.0	5.2	35	0.490
3/16	4	S	N	BLACK CRAPPIE	4.2	4.6	127	2.038
3/16	2	S	N	PERCHES	10.1	10.1	1	0.020
3/16	3	S	N	PERCHES	5.1	5.1	1	0.014
3/21	1	B	D	HERRINGS	4.6	6.0	503	8.718
3/21	2	B	D	HERRINGS	4.9	7.3	689	10.733
3/21	3	B	D	HERRINGS	4.8	8.2	500	7.687
3/21	4	B	D	HERRINGS	4.3	5.7	423	8.256
3/21	1	B	D	TIDEWATER SILVERSIDE	6.1	6.1	1	0.017
3/21	2	B	D	TIDEWATER SILVERSIDE	4.2	5.8	2	0.031
3/21	1	B	D	BLACK CRAPPIE	4.2	4.3	7	0.121
3/21	2	B	D	BLACK CRAPPIE	4.3	4.5	6	0.093
3/21	3	B	D	BLACK CRAPPIE	4.0	4.6	9	0.138
3/21	4	B	D	BLACK CRAPPIE	4.5	4.6	3	0.059
3/21	1	B	D	PERCHES	4.9	4.9	1	0.017
3/21	3	B	D	PERCHES	4.8	4.8	1	0.015
3/21	4	B	D	PERCHES	5.7	5.7	1	0.020
3/21	2	B	N	HERRINGS	5.4	6.1	466	7.251
3/21	3	B	N	HERRINGS	5.4	6.4	425	9.020

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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/21	4	B	N	HERRINGS	5.2	6.0	488	8.862
3/21	2	B	N	TIDEWATER SILVERSIDE	4.3	5.4	2	0.031
3/21	3	B	N	TIDEWATER SILVERSIDE	5.5	5.5	1	0.021
3/21	4	B	N	TIDEWATER SILVERSIDE	3.3	5.8	2	0.036
3/21	2	B	N	BLACK CRAPPIE	4.3	4.6	10	0.156
3/21	3	B	N	BLACK CRAPPIE	4.3	4.6	9	0.191
3/21	4	B	N	BLACK CRAPPIE	4.6	4.8	3	0.054
3/21	1	S	D	HERRINGS	3.4	6.3	1271	18.815
3/21	2	S	D	HERRINGS	4.8	8.2	679	10.932
3/21	3	S	D	HERRINGS	4.3	6.1	1027	16.695
3/21	4	S	D	HERRINGS	4.8	6.1	587	11.422
3/21	1	S	D	TIDEWATER SILVERSIDE	3.9	3.9	1	0.015
3/21	3	S	D	TIDEWATER SILVERSIDE	5.4	5.4	1	0.016
3/21	1	S	D	BLACK CRAPPIE	4.2	4.6	8	0.118
3/21	2	S	D	BLACK CRAPPIE	4.2	8.4	8	0.129
3/21	3	S	D	BLACK CRAPPIE	4.3	4.3	1	0.016
3/21	4	S	D	BLACK CRAPPIE	4.3	4.5	3	0.058
3/21	1	S	D	PERCHES	6.0	6.0	1	0.015
3/21	2	S	D	PERCHES	4.6	9.6	4	0.064

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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	* DEPTH	** PERIOD	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/21	3	S	D	PERCHES	7.9	7.9	1	0.016
3/21	4	S	D	PERCHES	4.9	4.9	1	0.019
3/21	2	S	N	HERRINGS	4.3	6.3	369	8.037
3/21	3	S	N	HERRINGS	4.3	6.3	439	7.652
3/21	4	S	N	HERRINGS	4.5	5.8	565	9.878
3/21	3	S	N	TIDEWATER SILVERSIDE	4.2	4.2	1	0.017
3/21	4	S	N	TIDEWATER SILVERSIDE	4.6	4.6	1	0.017
3/21	2	S	N	BLACK CRAPPIE	4.5	4.6	6	0.131
3/21	3	S	N	BLACK CRAPPIE	3.4	4.3	8	0.139
3/21	4	S	N	BLACK CRAPPIE	4.3	4.6	6	0.105
3/21	4	S	N	PERCHES	9.3	9.3	1	0.017
3/22	1	B	N	HERRINGS	4.9	6.1	481	7.335
3/22	1	B	N	TIDEWATER SILVERSIDE	5.8	19.8	2	0.030
3/22	1	B	N	BLACK CRAPPIE	4.3	4.6	6	0.091
3/22	1	S	N	HERRINGS	4.8	8.4	212	3.751
3/22	1	S	N	TIDEWATER SILVERSIDE	4.6	5.4	3	0.053
3/22	1	S	N	BLACK CRAPPIE	4.0	4.6	8	0.142
3/23	3	B	D		.	.	.	.
3/23	1	B	D	HERRINGS	5.4	9.1	1231	18.561

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**
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APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/23	2	B	D	HERRINGS	4.6	10.0	1194	17.154
3/23	4	B	D	HERRINGS	5.8	7.0	187	2.699
3/23	1	B	D	TIDEWATER SILVERSIDE	4.5	4.8	4	0.060
3/23	1	B	D	BLACK CRAPPIE	4.3	4.8	5	0.075
3/23	2	B	D	BLACK CRAPPIE	4.5	5.2	14	0.201
3/23	4	B	D	BLACK CRAPPIE	4.3	4.5	4	0.058
3/23	2	B	N	HERRINGS	4.8	10.8	217	2.971
3/23	3	B	N	HERRINGS	4.3	9.6	354	6.001
3/23	4	B	N	HERRINGS	3.9	10.5	518	7.668
3/23	2	B	N	TIDEWATER SILVERSIDE	4.5	5.1	7	0.096
3/23	3	B	N	TIDEWATER SILVERSIDE	4.5	5.4	3	0.051
3/23	4	B	N	TIDEWATER SILVERSIDE	4.6	4.9	12	0.178
3/23	2	B	N	BLACK CRAPPIE	4.3	4.6	11	0.151
3/23	3	B	N	BLACK CRAPPIE	4.3	4.6	18	0.305
3/23	4	B	N	BLACK CRAPPIE	4.2	5.1	21	0.311
3/23	2	B	N	PERCHES	7.3	7.3	1	0.014
3/23	2	S	D		.	.	.	.
3/23	1	S	D	HERRINGS	6.1	9.3	995	12.770
3/23	3	S	D	HERRINGS	6.0	6.9	2305	28.706

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**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/23	4	S	D	HERRINGS	5.4	6.9	2415	38.834
3/23	1	S	D	TIDEWATER SILVERSIDE	4.5	5.2	7	0.090
3/23	4	S	D	TIDEWATER SILVERSIDE	4.9	5.5	5	0.080
3/23	1	S	D	BLACK CRAPPIE	4.9	4.9	1	0.013
3/23	3	S	D	BLACK CRAPPIE	.	.	24	0.299
3/23	4	S	D	BLACK CRAPPIE	4.2	4.8	18	0.289
3/23	4	S	D	PERCHES	4.6	4.6	1	0.016
3/23	2	S	N	HERRINGS	4.5	7.2	181	2.760
3/23	3	S	N	HERRINGS	5.1	9.1	391	5.567
3/23	4	S	N	HERRINGS	4.6	7.0	459	7.078
3/23	2	S	N	ATLANTIC NEEDLEFISH	13.3	13.3	1	0.015
3/23	2	S	N	TIDEWATER SILVERSIDE	4.6	4.8	3	0.046
3/23	3	S	N	TIDEWATER SILVERSIDE	4.6	5.1	5	0.071
3/23	4	S	N	TIDEWATER SILVERSIDE	4.6	4.8	8	0.123
3/23	2	S	N	BLACK CRAPPIE	4.0	4.5	10	0.152
3/23	3	S	N	BLACK CRAPPIE	4.2	4.5	33	0.470
3/23	4	S	N	BLACK CRAPPIE	3.9	4.3	28	0.432
3/23	2	S	N	PERCHES	6.1	6.1	1	0.015
3/23	4	S	N	PERCHES	9.7	9.7	1	0.015

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/23	3	S	N	EGGS	1.1	1.1	1	0.014
3/24	1	B	N	HERRINGS	4.9	6.6	355	6.100
3/24	1	B	N	TIDEWATER SILVERSIDE	4.5	5.1	2	0.034
3/24	1	B	N	BLACK CRAPPIE	4.3	5.2	5	0.086
3/24	1	S	N	HERRINGS	3.9	7.0	325	4.260
3/24	1	S	N	ATLANTIC NEEDLEFISH	11.5	11.5	1	0.013
3/24	1	S	N	TIDEWATER SILVERSIDE	4.2	4.6	5	0.066
3/24	1	S	N	BLACK CRAPPIE	3.9	4.9	2	0.026
3/28	1	B	D	HERRINGS	4.6	7.3	1000	20.712
3/28	2	B	D	HERRINGS	3.4	8.2	193	4.339
3/28	3	B	D	HERRINGS	4.8	10.0	41	0.997
3/28	4	B	D	HERRINGS	5.2	9.4	82	1.443
3/28	3	B	D	TIDEWATER SILVERSIDE	4.9	6.3	2	0.049
3/28	4	B	D	TIDEWATER SILVERSIDE	4.3	4.6	3	0.053
3/28	3	B	D	SUNFISHES	6.1	6.1	1	0.024
3/28	2	B	D	BLACK CRAPPIE	4.2	4.2	1	0.022
3/28	3	B	D	BLACK CRAPPIE	4.2	4.2	1	0.024
3/28	4	B	D	BLACK CRAPPIE	4.2	4.9	13	0.229
3/28	4	B	D	PERCHES	3.8	4.7	4	0.070

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/28	1	B	N	HERRINGS	5.2	15.3	935	14.691
3/28	2	B	N	HERRINGS	5.5	10.5	166	2.953
3/28	3	B	N	HERRINGS	5.1	12.4	454	9.882
3/28	4	B	N	HERRINGS	4.2	10.3	477	8.347
3/28	1	B	N	TIDEWATER SILVERSIDE	4.8	6.7	23	0.361
3/28	2	B	N	TIDEWATER SILVERSIDE	4.5	5.5	35	0.623
3/28	3	B	N	TIDEWATER SILVERSIDE	4.8	5.1	22	0.479
3/28	4	B	N	TIDEWATER SILVERSIDE	5.2	16.5	27	0.472
3/28	2	B	N	BLACK CRAPPIE	4.0	4.6	7	0.125
3/28	3	B	N	BLACK CRAPPIE	3.9	4.2	12	0.261
3/28	4	B	N	BLACK CRAPPIE	4.2	4.5	39	0.682
3/28	2	B	N	CLOWN GOBY	3.7	3.8	2	0.036
3/28	1	S	D	HERRINGS	4.2	10.5	810	12.592
3/28	2	S	D	HERRINGS	4.8	10.6	38	0.911
3/28	3	S	D	HERRINGS	5.1	10.3	280	3.746
3/28	4	S	D	HERRINGS	3.6	9.7	88	1.990
3/28	1	S	D	TIDEWATER SILVERSIDE	4.6	18.1	6	0.093
3/28	2	S	D	TIDEWATER SILVERSIDE	4.8	9.3	4	0.096
3/28	3	S	D	TIDEWATER SILVERSIDE	4.9	6.0	11	0.147

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/28	4	S	D	TIDEWATER SILVERSIDE	4.3	4.3	1	0.023
3/28	3	S	D	SUNFISHES	5.6	5.6	1	0.013
3/28	4	S	D	SUNFISHES	5.4	5.4	1	0.023
3/28	1	S	D	BLACK CRAPPIE	4.2	6.3	5	0.078
3/28	2	S	D	BLACK CRAPPIE	6.1	6.1	1	0.024
3/28	3	S	D	BLACK CRAPPIE	4.6	6.1	3	0.040
3/28	4	S	D	BLACK CRAPPIE	4.2	4.5	17	0.384
3/28	1	S	D	CLOWN GOBY	3.6	3.6	1	0.016
3/28	1	S	N	HERRINGS	5.7	10.0	610	14.273
3/28	2	S	N	HERRINGS	4.8	12.4	250	5.056
3/28	3	S	N	HERRINGS	5.1	14.5	193	4.351
3/28	4	S	N	HERRINGS	5.4	16.6	283	6.222
3/28	2	S	N	TIDEWATER SILVERSIDE	4.5	6.0	39	0.789
3/28	3	S	N	TIDEWATER SILVERSIDE	5.2	15.6	28	0.631
3/28	4	S	N	TIDEWATER SILVERSIDE	4.6	5.8	32	0.704
3/28	2	S	N	BLACK CRAPPIE	4.3	5.4	12	0.243
3/28	3	S	N	BLACK CRAPPIE	4.2	10.2	27	0.609
3/28	4	S	N	BLACK CRAPPIE	3.9	10.2	63	1.385
3/28	3	S	N	CLOWN GOBY	3.5	3.5	1	0.023

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1976
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/30	1	B	D	HERRINGS	3.7	10.8	192	2.532
3/30	2	B	D	HERRINGS	5.1	10.8	1140	16.047
3/30	3	B	D	HERRINGS	4.6	10.9	646	8.300
3/30	4	B	D	HERRINGS	4.8	10.6	1694	23.672
3/30	2	B	D	ATLANTIC NEEDLEFISH	11.4	11.4	1	0.014
3/30	2	B	D	TIDEWATER SILVERSIDE	5.5	6.4	4	0.056
3/30	3	B	D	TIDEWATER SILVERSIDE	4.8	5.7	4	0.051
3/30	4	B	D	TIDEWATER SILVERSIDE	4.5	5.4	5	0.070
3/30	1	B	D	BLACK CRAPPIE	4.0	4.3	20	0.264
3/30	2	B	D	BLACK CRAPPIE	4.2	4.6	13	0.183
3/30	3	B	D	BLACK CRAPPIE	3.9	6.1	11	0.141
3/30	4	B	D	BLACK CRAPPIE	4.2	4.5	21	0.293
3/30	2	B	D	PERCHES	5.2	5.2	1	0.014
3/30	3	B	D	PERCHES	5.5	5.5	1	0.013
3/30	1	B	D	CLOWN GOBY	3.8	3.8	1	0.013
3/30	3	B	D	CLOWN GOBY	4.2	4.5	6	0.077
3/30	4	B	D	CLOWN GOBY	3.6	3.8	4	0.056
3/30	4	B	D	EGGS	0.9	0.9	1	0.014
3/30	1	B	N	HERRINGS	5.1	13.0	909	14.028

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/30	2	B	N	HERRINGS	4.5	12.0	862	11.821
3/30	3	B	N	HERRINGS	4.9	11.2	1438	20.294
3/30	4	B	N	HERRINGS	4.6	10.2	1299	19.367
3/30	1	B	N	ATLANTIC NEEDLEFISH	12.6	12.7	2	0.031
3/30	2	B	N	ATLANTIC NEEDLEFISH	13.5	14.2	2	0.027
3/30	1	B	N	TIDEWATER SILVERSIDE	4.5	7.3	8	0.123
3/30	2	B	N	TIDEWATER SILVERSIDE	4.8	6.3	20	0.274
3/30	3	B	N	TIDEWATER SILVERSIDE	5.1	10.2	28	0.395
3/30	1	B	N	BLACK CRAPPIE	4.2	10.5	12	0.185
3/30	2	B	N	BLACK CRAPPIE	4.0	4.3	15	0.206
3/30	3	B	N	BLACK CRAPPIE	4.3	4.6	42	0.593
3/30	4	B	N	BLACK CRAPPIE	4.1	4.5	151	2.251
3/30	1	B	N	CLOWN GOBY	3.6	3.6	1	0.015
3/30	1	S	D	HERRINGS	4.9	11.8	3731	28.102
3/30	2	S	D	HERRINGS	4.9	13.8	2441	40.470
3/30	3	S	D	HERRINGS	5.4	9.0	1437	21.837
3/30	4	S	D	HERRINGS	5.5	15.6	3945	57.643
3/30	1	S	D	TIDEWATER SILVERSIDE	5.7	6.4	3	0.023
3/30	2	S	D	TIDEWATER SILVERSIDE	4.9	7.2	19	0.315

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
CATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/30	4	S	D	TIDEWATER SILVERSIDE	5.1	6.0	5	0.073
3/30	1	S	D	BLACK CRAPPIE	4.2	4.5	10	0.075
3/30	2	S	D	BLACK CRAPPIE	4.3	4.5	7	0.116
3/30	4	S	D	BLACK CRAPPIE	3.7	4.5	15	0.219
3/30	2	S	D	PERCHES	4.5	4.5	2	0.033
3/30	1	S	D	CLOWN GOBY	4.1	4.4	2	0.015
3/30	1	S	N	HERRINGS	3.6	10.5	718	10.840
3/30	2	S	N	HERRINGS	4.6	16.8	460	6.895
3/30	3	S	N	HERRINGS	5.1	13.8	1266	21.758
3/30	4	S	N	HERRINGS	4.8	18.4	1999	29.739
3/30	2	S	N		15.1	15.1	1	0.015
3/30	2	S	N	ATLANTIC NEEDLEFISH	12.1	19.3	2	0.030
3/30	1	S	N	TIDEWATER SILVERSIDE	4.3	6.4	22	0.332
3/30	2	S	N	TIDEWATER SILVERSIDE	5.2	14.7	31	0.465
3/30	3	S	N	TIDEWATER SILVERSIDE	4.8	10.2	42	0.722
3/30	4	S	N	TIDEWATER SILVERSIDE	4.6	12.0	40	0.595
3/30	4	S	N	BLACK CRAPPIE	9.8	9.8	1	0.015
3/30	1	S	N	BLACK CRAPPIE	4.2	11.7	6	0.091
3/30	2	S	N	BLACK CRAPPIE	4.2	4.6	22	0.330

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
3/30	3	S	N	BLACK CRAPPIE	3.9	4.6	60	1.031
3/30	4	S	N	BLACK CRAPPIE	3.9	4.6	99	1.473
3/30	2	S	N	CLOWN GOBY	12.7	19.0	4	0.060
3/30	3	S	N	CLOWN GOBY	3.4	6.3	5	0.086
3/30	4	S	N	CLOWN GOBY	3.9	4.5	3	0.045
4/ 4	4	B	D		.	.	.	.
4/ 4	1	B	D	HERRINGS	4.6	7.5	80	1.419
4/ 4	2	B	D	HERRINGS	4.3	13.2	85	1.315
4/ 4	3	B	D	HERRINGS	4.6	5.7	54	0.853
4/ 4	2	B	D	SUNFISHES	5.7	5.7	1	0.015
4/ 4	1	B	D	BLACK CRAPPIE	4.3	4.3	1	0.018
4/ 4	3	B	D	BLACK CRAPPIE	4.0	4.2	4	0.063
4/ 4	3	B	D	PERCHES	3.7	3.7	1	0.016
4/ 4	2	B	D	CLOWN GOBY	3.8	3.8	1	0.015
4/ 4	1	B	N	HERRINGS	5.1	5.8	130	2.417
4/ 4	2	B	N	HERRINGS	4.9	5.7	66	1.519
4/ 4	3	B	N	HERRINGS	5.1	8.8	179	3.193
4/ 4	4	B	N	HERRINGS	5.1	6.0	309	4.868
4/ 4	1	B	N	TIDEWATER SILVERSIDE	4.5	4.5	1	0.019

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH *	PERIOD **	CATEGORY	SIZE RANGE MIN.	MAX.	NUMBER	NO./M3
4/ 4	1	B	N	BLACK CRAPPIE	3.9	4.2	3	0.056
4/ 4	2	B	N	BLACK CRAPPIE	4.0	4.3	12	0.276
4/ 4	3	B	N	BLACK CRAPPIE	3.9	4.3	224	3.995
4/ 4	4	B	N	BLACK CRAPPIE	3.9	4.3	99	1.560
4/ 4	1	B	N	CLOWN GOBY	3.6	3.7	2	0.037
4/ 4	2	B	N	CLOWN GOBY	3.4	3.7	5	0.115
4/ 4	1	S	D	HERRINGS	5.5	5.8	256	4.036
4/ 4	2	S	D	HERRINGS	4.8	5.5	352	6.062
4/ 4	3	S	D	HERRINGS	4.9	5.7	123	2.005
4/ 4	4	S	D	HERRINGS	5.5	6.1	277	4.573
4/ 4	3	S	D	BLACK CRAPPIE	4.2	4.5	5	0.082
4/ 4	4	S	D	BLACK CRAPPIE	4.5	4.5	1	0.017
4/ 4	3	S	D	CLOWN GOBY	3.9	3.9	1	0.016
4/ 4	4	S	D	CLOWN GOBY	3.7	3.7	1	0.017
4/ 4	1	S	N	HERRINGS	5.2	6.0	150	3.290
4/ 4	2	S	N	HERRINGS	4.5	5.5	66	1.725
4/ 4	3	S	N	HERRINGS	5.7	12.0	112	2.022
4/ 4	4	S	N	HERRINGS	5.5	14.5	90	2.152
4/ 4	3	S	N	SHINERS	6.9	6.9	1	0.018

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 18
(CONTINUED)
DATA LIST FOR FISH LARVAE AND EGGS ENTRAINMENT STUDY
BY DEPTH AND PERIOD
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	DEPTH*	PERIOD**	CATEGORY	SIZE RANGE MIN.	SIZE RANGE MAX.	NUMBER	NO./M3
4/ 4	2	S	N	TIDEWATER SILVERSIDE	4.6	4.6	1	0.026
4/ 4	3	S	N	TIDEWATER SILVERSIDE	4.9	4.9	1	0.018
4/ 4	1	S	N	BLACK CRAPPIE	4.0	4.3	6	0.132
4/ 4	2	S	N	BLACK CRAPPIE	3.7	4.3	9	0.235
4/ 4	3	S	N	BLACK CRAPPIE	4.0	4.3	124	2.239
4/ 4	4	S	N	BLACK CRAPPIE	4.0	4.5	153	3.658
4/ 4	3	S	N	PERCHES	3.7	3.7	1	0.018
4/ 4	1	S	N	CLOWN GOBY	3.4	3.6	3	0.066
4/ 4	2	S	N	CLOWN GOBY	3.4	3.4	1	0.026
4/ 4	3	S	N	CLOWN GOBY	3.6	3.7	2	0.036

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 19

TOTAL LARVAL AND EGG DENSITIES FOR ENTRAINMENT STUDY
BY DATE
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	PERIOD **	DEPTH *	LARVAE SIZE RANGE MIN.	LARVAE SIZE RANGE MAX.	LARVAE NO./M3	EGGS SIZERANGE MIN.	EGGS SIZERANGE MAX.	EGGS NO./M3
2/ 7	1	D	B	4.6	11.2	0.049	.	.	0.000
2/ 7	1	D	S	4.6	11.0	0.114	.	.	0.000
2/ 7	1	N	B	4.9	11.0	0.119	.	.	0.000
2/ 7	1	N	S	5.0	13.0	0.113	.	.	0.000
2/ 7	2	D	B	4.2	11.0	0.093	.	.	0.000
2/ 7	2	D	S	4.6	10.7	0.072	.	.	0.000
2/ 7	2	N	B	9.1	9.1	0.034	.	.	0.000
2/ 7	2	N	S	4.5	12.2	0.111	.	.	0.000
2/ 7	3	D	B	4.8	18.4	0.137	.	.	0.000
2/ 7	3	D	S	4.5	11.5	0.255	.	.	0.000
2/ 7	3	N	B	4.8	11.2	0.256	.	.	0.000
2/ 7	3	N	S	4.3	10.9	0.216	.	.	0.000
2/ 7	4	D	B	4.6	13.6	0.195	.	.	0.000
2/ 7	4	D	S	4.6	10.2	0.223	.	.	0.000
2/ 7	4	N	B	4.3	12.2	0.645	.	.	0.000
2/ 7	4	N	S	4.8	13.6	0.261	.	.	0.000
2/ 9	1	D	B	.	.	0.000	.	.	0.000
2/ 9	1	D	S	4.5	5.0	0.114	.	.	0.000
2/ 9	1	N	B	5.1	5.1	0.017	.	.	0.000
2/ 9	1	N	S	5.3	18.1	0.120	.	.	0.000
2/ 9	2	D	B	4.8	4.8	0.020	.	.	0.000
2/ 9	2	D	S	4.3	5.6	0.166	.	.	0.000
2/ 9	2	N	B	33.6	33.6	0.019	.	.	0.000
2/ 9	2	N	S	10.1	29.0	0.168	.	.	0.000
2/ 9	3	D	B	4.6	16.5	0.077	.	.	0.000
2/ 9	3	D	S	.	.	0.099	.	.	0.000
2/ 9	3	N	B	4.5	10.9	0.482	.	.	0.000
2/ 9	3	N	S	4.3	28.6	0.389	.	.	0.000
2/ 9	4	D	B	4.4	12.8	0.064	.	.	0.000
2/ 9	4	D	S	4.6	5.6	0.757	.	.	0.000
2/ 9	4	N	B	4.5	11.4	0.405	.	.	0.000
2/ 9	4	N	S	4.6	23.0	0.489	.	.	0.000
2/14	1	D	B	.	.	0.000	.	.	0.000
2/14	1	D	S	7.5	12.5	0.226	.	.	0.000
2/14	1	N	B	10.1	11.2	0.045	.	.	0.000
2/14	1	N	S	13.4	22.4	0.154	.	.	0.000
2/14	2	D	B	.	.	0.000	.	.	0.000
2/14	2	D	S	.	.	0.000	.	.	0.000
2/14	2	N	B	4.8	10.8	0.105	.	.	0.000

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 19
(CONTINUED)
TOTAL LARVAL AND EGG DENSITIES FOR ENTRAINMENT STUDY
BY DATE
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	** PERIOD	* DEPTH	LARVAE SIZE RANGE MIN.	LARVAE SIZE RANGE MAX.	LARVAE NO./M3	EGGS SIZERANGE MIN.	EGGS SIZERANGE MAX.	EGGS NO./M3
2/14	2	N	S	6.0	16.5	0.042	.	.	0.000
2/14	3	D	B	.	.	0.000	.	.	0.000
2/14	3	D	S	.	.	0.000	.	.	0.000
2/14	3	N	B	5.1	13.0	0.208	.	.	0.000
2/14	3	N	S	6.5	13.9	0.127	.	.	0.000
2/14	4	D	B	.	.	0.000	.	.	0.000
2/14	4	D	S	4.8	11.7	0.038	.	.	0.000
2/15	4	N	B	4.8	12.3	0.123	.	.	0.000
2/15	4	N	S	11.0	14.4	0.073	.	.	0.000
2/16	1	D	B	13.6	13.6	0.015	.	.	0.000
2/16	1	D	S	9.6	12.8	0.026	.	.	0.000
2/16	1	N	B	11.2	16.3	0.038	.	.	0.000
2/16	1	N	S	6.1	10.0	0.030	.	.	0.000
2/16	2	D	B	11.7	11.7	0.014	.	.	0.000
2/16	2	D	S	.	.	0.000	.	.	0.000
2/16	2	N	B	5.6	11.8	0.041	.	.	0.000
2/16	2	N	S	11.0	16.8	0.080	.	.	0.000
2/16	3	D	B	4.8	5.3	0.041	.	.	0.000
2/16	3	D	S	4.8	12.0	0.224	.	.	0.000
2/16	3	N	B	4.6	6.2	0.159	.	.	0.030
2/16	3	N	S	4.6	7.2	0.185	.	.	0.000
2/16	4	D	B	5.0	5.0	0.012	.	.	0.000
2/16	4	D	S	5.0	11.0	0.063	.	.	0.000
2/16	4	N	B	.	.	0.000	.	.	0.000
2/16	4	N	S	4.5	10.4	0.252	.	.	0.000
2/21	1	D	B	.	.	0.000	.	.	0.000
2/21	1	D	S	5.6	6.4	0.032	.	.	0.000
2/21	1	N	B	4.8	5.9	0.386	.	.	0.000
2/21	1	N	S	4.5	21.0	0.430	.	.	0.000
2/21	2	D	B	.	.	0.000	.	.	0.000
2/21	2	D	S	.	.	0.000	.	.	0.000
2/21	2	N	B	5.0	6.2	0.537	.	.	0.000
2/21	2	N	S	4.8	15.0	0.502	.	.	0.000
2/21	3	D	B	.	.	0.000	.	.	0.000
2/21	3	D	S	.	.	0.000	.	.	0.000
2/21	3	N	B	4.4	6.1	0.722	.	.	0.000
2/21	3	N	S	5.3	11.4	0.502	.	.	0.000
2/21	4	D	B	4.6	9.4	2.152	.	.	0.000

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 19
(CONTINUED)
TOTAL LARVAL AND EGG DENSITIES FOR ENTRAINMENT STUDY
BY DATE
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	** PERIOD	* DEPTH	LARVAE SIZE RANGE MIN.	MAX.	LARVAE NO./M3	EGGS SIZERANGE MIN.	MAX.	EGGS NO./M3
2/21	4	D	S	5.0	5.7	1.791	.	.	0.000
2/21	4	N	B	4.5	6.3	0.994	.	.	0.000
2/21	4	N	S	4.5	10.9	0.374	.	.	0.000
2/23	1	D	B	5.5	5.5	0.017	.	.	0.000
2/23	1	D	S	4.2	11.7	0.501	.	.	0.000
2/23	1	N	B	4.5	5.5	0.170	.	.	0.000
2/23	1	N	S	4.8	14.8	0.137	.	.	0.000
2/23	2	D	B	4.8	13.2	0.038	.	.	0.000
2/23	2	D	S	4.8	10.9	0.098	.	.	0.000
2/23	2	N	B	4.5	4.6	0.071	.	.	0.000
2/23	2	N	S	4.6	5.8	0.064	.	.	0.000
2/23	3	D	B	4.1	6.0	0.100	.	.	0.000
2/23	3	D	S	5.2	5.2	0.019	.	.	0.000
2/23	4	D	B	4.5	4.9	0.069	.	.	0.000
2/23	4	D	S	4.3	5.7	0.115	.	.	0.000
2/24	3	N	B	4.5	9.9	0.161	.	.	0.000
2/24	3	N	S	4.0	11.1	0.190	.	.	0.000
2/24	4	N	B	3.7	10.3	0.112	.	.	0.000
2/24	4	N	S	4.6	9.3	0.266	.	.	0.000
3/ 2	1	D	B	4.9	6.0	0.076	.	.	0.000
3/ 2	1	D	S	4.6	10.9	0.297	.	.	0.000
3/ 2	1	N	B	4.8	5.5	0.076	.	.	0.000
3/ 2	1	N	S	4.2	5.7	0.148	.	.	0.000
3/ 2	2	D	B	4.6	5.1	0.156	.	.	0.000
3/ 2	2	D	S	4.8	6.0	0.039	.	.	0.000
3/ 2	2	N	B	4.4	8.9	0.081	.	.	0.000
3/ 2	2	N	S	4.7	14.0	0.069	.	.	0.000
3/ 2	3	D	B	4.8	5.1	0.161	.	.	0.000
3/ 2	3	D	S	4.5	6.0	0.213	.	.	0.000
3/ 2	3	N	B	4.2	6.1	0.224	.	.	0.000
3/ 2	3	N	S	4.2	9.7	0.509	.	.	0.000
3/ 2	4	D	B	4.1	5.5	0.134	.	.	0.000
3/ 2	4	D	S	4.2	5.2	0.144	.	.	0.000
3/ 2	4	N	B	3.9	11.1	0.237	.	.	0.000
3/ 2	4	N	S	4.1	10.2	0.421	.	.	0.000
3/ 7	1	D	B	5.2	6.1	3.986	.	.	0.000
3/ 7	1	D	S	4.0	6.7	0.311	.	.	0.000
3/ 7	2	D	B	5.2	5.7	13.771	.	.	0.000

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 19
(CONTINUED)
TOTAL LARVAL AND EGG DENSITIES FOR ENTRAINMENT STUDY
BY DATE
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	** PERIOD	* DEPTH	LARVAE SIZE RANGE MIN.	LARVAE SIZE RANGE MAX.	LARVAE NO./M3	EGGS SIZERANGE MIN.	EGGS SIZERANGE MAX.	EGGS NO./M3
3/ 7	2	D	S	3.9	6.1	1.326	.	.	0.000
3/ 7	2	N	S	4.5	6.0	9.616	.	.	0.000
3/ 7	3	D	B	4.8	5.8	8.163	.	.	0.000
3/ 7	3	D	S	4.8	5.7	4.012	.	.	0.000
3/ 7	3	N	B	4.3	6.1	16.853	.	.	0.000
3/ 7	3	N	S	4.5	6.0	12.776	.	.	0.000
3/ 7	4	D	B	4.5	6.0	14.032	.	.	0.000
3/ 7	4	D	S	4.8	6.4	12.256	.	.	0.000
3/ 7	4	N	B	4.5	6.3	21.498	.	.	0.000
3/ 7	4	N	S	4.3	6.4	13.756	.	.	0.000
3/ 8	1	N	B	5.1	6.6	13.411	.	.	0.000
3/ 8	1	N	S	5.2	5.8	11.862	.	.	0.000
3/ 8	2	N	B	4.5	11.2	11.349	.	.	0.000
3/ 9	1	D	B	3.8	6.0	2.600	.	.	0.000
3/ 9	1	D	S	4.2	6.0	5.512	.	.	0.000
3/ 9	1	N	B	4.5	6.7	6.844	.	.	0.000
3/ 9	1	N	S	4.2	6.7	4.112	.	.	0.000
3/ 9	2	D	B	4.3	6.1	7.255	.	.	0.000
3/ 9	2	D	S	4.3	7.6	7.406	.	.	0.000
3/ 9	2	N	B	4.3	6.1	4.100	.	.	0.000
3/ 9	2	N	S	4.2	21.3	5.524	.	.	0.000
3/ 9	3	D	B	4.2	6.1	8.049	.	.	0.000
3/ 9	3	D	S	4.3	6.7	14.234	.	.	0.000
3/ 9	3	N	B	3.9	5.8	8.739	.	.	0.000
3/ 9	3	N	S	3.2	6.9	6.742	.	.	0.000
3/ 9	4	D	B	3.9	6.3	4.731	.	.	0.000
3/ 9	4	D	S	4.8	6.3	7.516	.	.	0.000
3/ 9	4	N	B	4.3	8.1	10.601	.	.	0.000
3/ 9	4	N	S	3.7	6.3	8.764	.	.	0.000
3/14	1	D	B	3.7	5.4	0.481	.	.	0.000
3/14	1	D	S	4.6	7.3	0.494	.	.	0.000
3/14	1	N	B	4.2	6.6	2.194	.	.	0.000
3/14	1	N	S	4.5	6.7	1.749	.	.	0.000
3/14	2	D	B	4.5	5.4	0.538	.	.	0.000
3/14	2	D	S	4.2	6.9	0.495	.	.	0.000
3/14	3	D	B	3.6	7.2	0.461	.	.	0.000
3/14	3	D	S	4.1	7.5	0.324	.	.	0.000
3/14	3	N	B	4.6	6.4	0.392	.	.	0.000

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 19
(CONTINUED)
TOTAL LARVAL AND EGG DENSITIES FOR ENTRAINMENT STUDY
BY DATE
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	** PERIOD	* DEPTH	LARVAE SIZE RANGE MIN.	MAX.	LARVAE NO./M3	EGGS SIZERANGE MIN.	MAX.	EGGS NO./M3
3/14	3	N	S	4.2	6.4	0.301	.	.	0.000
3/14	4	D	B	4.5	16.8	0.669	.	.	0.000
3/14	4	D	S	3.9	6.0	0.274	.	.	0.000
3/14	4	N	B	4.3	5.8	0.831	.	.	0.000
3/14	4	N	S	4.2	7.6	0.609	.	.	0.000
3/15	2	N	B	4.9	6.7	1.282	.	.	0.000
3/15	2	N	S	4.5	6.4	0.670	.	.	0.000
3/16	1	D	B	3.7	6.0	0.497	.	.	0.000
3/16	1	D	S	4.2	7.5	1.002	.	.	0.000
3/16	1	N	B	3.9	9.1	3.927	.	.	0.000
3/16	1	N	S	4.2	8.7	5.228	.	.	0.000
3/16	2	D	B	3.9	7.8	0.924	.	.	0.000
3/16	2	D	S	4.2	5.7	1.508	.	.	0.000
3/16	2	N	B	4.2	7.9	3.674	.	.	0.000
3/16	2	N	S	4.2	10.1	3.871	.	.	0.000
3/16	3	D	B	4.3	6.7	0.534	.	.	0.000
3/16	3	D	S	4.2	7.5	0.980	.	.	0.000
3/16	3	N	B	4.2	8.8	0.901	.	.	0.000
3/16	3	N	S	4.0	9.1	2.114	.	.	0.000
3/16	4	D	B	4.0	8.2	0.819	.	.	0.000
3/16	4	D	S	4.6	7.3	0.446	.	.	0.000
3/16	4	N	B	4.3	13.0	2.144	.	.	0.000
3/16	4	N	S	4.2	9.4	4.397	.	.	0.000
3/21	1	D	B	4.2	6.1	8.874	.	.	0.000
3/21	1	D	S	3.4	6.3	18.963	.	.	0.000
3/21	2	D	B	4.2	7.3	10.857	.	.	0.000
3/21	2	D	S	4.2	9.6	11.125	.	.	0.000
3/21	2	N	B	4.3	6.1	7.438	.	.	0.000
3/21	2	N	S	4.3	6.3	8.168	.	.	0.000
3/21	3	D	B	4.0	8.2	7.841	.	.	0.000
3/21	3	D	S	4.3	7.9	16.744	.	.	0.000
3/21	3	N	B	4.3	6.4	9.232	.	.	0.000
3/21	3	N	S	3.4	6.3	7.809	.	.	0.000
3/21	4	D	B	4.3	5.7	8.334	.	.	0.000
3/21	4	D	S	4.3	6.1	11.500	.	.	0.000
3/21	4	N	B	3.3	6.0	8.953	.	.	0.000
3/21	4	N	S	4.3	9.3	10.018	.	.	0.000
3/22	1	N	B	4.3	19.8	7.456	.	.	0.000

*
S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.
**
D=DAY; N=NIGHT.

APPENDIX TABLE 19
(CONTINUED)
TOTAL LARVAL AND EGG DENSITIES FOR ENTRAINMENT STUDY
BY DATE
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	** PERIOD	* DEPTH	LARVAE SIZE RANGE MIN.	MAX.	LARVAE NO./M3	EGGS SIZERANGE MIN.	MAX.	EGGS NO./M3
3/22	1	N	S	4.0	8.4	3.945	.	.	0.000
3/23	1	D	B	4.3	9.1	18.697	.	.	0.000
3/23	1	D	S	4.5	9.3	12.872	.	.	0.000
3/23	2	D	B	4.5	10.0	17.355	.	.	0.000
3/23	2	D	S	.	.	.	.	.	0.000
3/23	2	N	B	4.3	10.8	3.231	.	.	0.000
3/23	2	N	S	4.0	13.3	2.989	.	.	0.000
3/23	3	D	B	.	.	.	.	.	0.000
3/23	3	D	S	6.0	6.9	29.005	.	.	0.000
3/23	3	N	B	4.3	9.6	6.357	.	.	0.000
3/23	3	N	S	4.2	9.1	6.108	1.1	1.1	0.014
3/23	4	D	B	4.3	7.0	2.756	.	.	0.000
3/23	4	D	S	4.2	6.9	39.220	.	.	0.000
3/23	4	N	B	3.9	10.5	9.156	.	.	0.000
3/23	4	N	S	3.9	9.7	7.648	.	.	0.000
3/24	1	N	B	4.3	6.6	6.220	.	.	0.000
3/24	1	N	S	3.9	11.5	4.365	.	.	0.000
3/28	1	D	B	4.6	7.3	20.712	.	.	0.000
3/28	1	D	S	3.6	18.1	12.779	.	.	0.000
3/28	1	N	B	4.8	15.3	15.052	.	.	0.000
3/28	1	N	S	5.7	10.0	14.273	.	.	0.000
3/28	2	D	B	3.4	8.2	4.361	.	.	0.000
3/28	2	D	S	4.8	10.6	1.031	.	.	0.000
3/28	2	N	B	3.7	10.5	3.735	.	.	0.000
3/28	2	N	S	4.3	12.4	6.087	.	.	0.000
3/28	3	D	B	4.2	10.0	1.095	.	.	0.000
3/28	3	D	S	4.6	10.3	3.947	.	.	0.000
3/28	3	N	B	3.9	12.4	10.623	.	.	0.000
3/28	3	N	S	3.5	15.6	5.613	.	.	0.000
3/28	4	D	B	3.8	9.4	1.795	.	.	0.000
3/28	4	D	S	3.6	9.7	2.420	.	.	0.000
3/28	4	N	B	4.2	16.5	9.502	.	.	0.000
3/28	4	N	S	3.9	16.6	8.311	.	.	0.000
3/30	1	D	B	3.7	10.8	2.809	.	.	0.000
3/30	1	D	S	4.1	11.8	28.215	.	.	0.000
3/30	1	N	B	3.6	13.0	14.383	.	.	0.000
3/30	1	N	S	3.6	11.7	11.262	.	.	0.000
3/30	2	D	B	4.2	11.4	16.315	.	.	0.000

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

APPENDIX TABLE 19
(CONTINUED)
TOTAL LARVAL AND EGG DENSITIES FOR ENTRAINMENT STUDY
BY DATE
FEBRUARY - APRIL 1978
MARTIN PLANT

DATE	STATION	** PERIOD	* DEPTH	LARVAE SIZE RANGE MIN.	LARVAE SIZE RANGE MAX.	LARVAE NO./M3	EGGS SIZERANGE MIN.	EGGS SIZERANGE MAX.	EGGS NO./M3
3/30	2	D	S	4.3	13.8	40.934	.	.	0.000
3/30	2	N	B	4.0	14.2	12.328	.	.	0.000
3/30	2	N	S	4.2	19.3	7.794	.	.	0.000
3/30	3	D	B	3.9	10.9	8.582	.	.	0.000
3/30	3	D	S	5.4	9.0	21.837	.	.	0.000
3/30	3	N	B	4.3	11.2	21.282	.	.	0.000
3/30	3	N	S	3.4	13.8	23.597	.	.	0.000
3/30	4	D	B	3.6	10.6	24.091	0.9	0.9	0.014
3/30	4	D	S	3.7	15.6	57.936	.	.	0.000
3/30	4	N	B	4.1	10.2	21.618	.	.	0.000
3/30	4	N	S	3.9	18.4	31.866	.	.	0.000
4/ 4	1	D	B	4.3	7.5	1.437	.	.	0.000
4/ 4	1	D	S	5.5	5.8	4.036	.	.	0.000
4/ 4	1	N	B	3.6	5.8	2.529	.	.	0.000
4/ 4	1	N	S	3.4	6.0	3.488	.	.	0.000
4/ 4	2	D	B	3.8	13.2	1.346	.	.	0.000
4/ 4	2	D	S	4.8	5.5	6.062	.	.	0.000
4/ 4	2	N	B	3.4	5.7	1.910	.	.	0.000
4/ 4	2	N	S	3.4	5.5	2.013	.	.	0.000
4/ 4	3	D	B	3.7	5.7	0.932	.	.	0.000
4/ 4	3	D	S	3.9	5.7	2.103	.	.	0.000
4/ 4	3	N	B	3.9	8.8	7.188	.	.	0.000
4/ 4	3	N	S	3.6	12.0	4.351	.	.	0.000
4/ 4	4	D	B	.	.	.	.	.	0.000
4/ 4	4	D	S	3.7	6.1	4.606	.	.	0.000
4/ 4	4	N	B	3.9	6.0	6.427	.	.	0.000
4/ 4	4	N	S	4.0	14.5	5.809	.	.	0.000

* S=SURFACE; M=MID-DEPTH; AND B=BOTTOM.

** D=DAY; N=NIGHT.

10.1.2 NPDES APPLICATIONS/PERMITS

Following is a copy of the current Martin Plant National Pollutant Discharge Elimination System (NPDES) Permit issued by the EPA in July 1989. It is anticipated that this permit will require a modification based on changes in the wastewater management system resulting from the addition of wastewater from the new combined cycle units. A copy of the letter to the U.S. EPA requesting a modification to the existing NPDES permit is attached. In addition, a Florida Coastal Management Program Consistency Certification is provided as part of the modification request.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

JUL 18 1989

RECEIVED

JUL 20 1989

MANAGER
PERMITTING & PROGRAMS

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Dr. Martin A. Smith, Ph.D.
Acting Manager
Environmental Permitting and Programs
Florida Power and Light Company
Post Office Box 078768
West Palm Beach, Florida 33407-0768

RE: Final Issuance of NPDES Permit No. FL0030988
Martin Steam Plant

Dear Dr. Smith:

Enclosed is the National Pollutant Discharge Elimination System (NPDES) permit for the above referenced facility. This action constitutes the Environmental Protection Agency's final permit decision in accordance with 40 C.F.R. Section 124.15(a). Any person may contest this decision by submitting a timely request for a hearing to the Regional Administrator under 40 C.F.R. Section 124.74 or Section 124.114.

The permit will be effective as specified in the permit, provided that no request for a hearing is granted by the Agency under 40 C.F.R. Section 124.75 or Section 124.114. In the event that such a request is granted:

- For discharge(s) previously authorized by an NPDES permit, the force and effect of the contested provision(s) of this permit will be stayed, and any comparable provision(s) of the previous NPDES permit as well as all uncontested provision(s) of this permit shall be fully enforceable and effective until the administrative review process is completed, as provided by 40 C.F.R. Sections 124.16 and 124.60.

- For discharge(s) not previously authorized by an NPDES permit, the Agency's granting of a hearing (requested by you or any other person) will result in no authorization to discharge. In other words, there will not be an NPDES permit authorizing the discharge(s) and, if such a discharge(s) occurs, the discharge(s) will constitute a violation of Section 301 of the Clean Water Act, 33 U.S.C. 1311, for which there is civil and/or criminal liability.

If you wish to request a hearing under 40 C.F.R. Section 124.74 or Section 124.114, you must submit a request (an original and two copies) to the Regional Hearing Clerk within thirty (30) days of the receipt of this letter. The request will be timely if mailed by certified mail within the thirty (30) day time period. For the request to be valid, it must conform to the requirements of 40 C.F.R. Section 124.74. A copy of the requirements of 40 C.F.R. Section 124.74 is enclosed.

Information on procedures pertaining to the filing of a hearing request or other legal matters may be obtained by contacting Ms. Jacqueline F. Colson, Assistant Regional Counsel, at (404) 347-2335.

Sincerely yours,

Bruce R. Barrett, Director
Water Management Division

Enclosures (3): Hearing Request Requirements
Final NPDES Permit
Amendment to the Fact Sheet

cc: Florida Department of Environmental Regulation (with Final Permit and Amendment to the Fact Sheet)

Major, Non-POTW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended (33 U.S.C. 1251 et seq.; the "Act"),

Florida Power and Light Company
Post Office Box 14000
Juno Beach, Florida 33408

is authorized to discharge from a facility located at

Martin Steam Plant
SR 710
Post Office Box 76
Indiantown, Florida 34956

to receiving waters named

St. Lucie Canal & L-65 Canal

in accordance with effluent limitations, monitoring requirements, and other conditions set forth herein. The permit consists of this cover sheet, Part I 6 pages, Part II 16 pages, Part III 3 pages, Part IV 2 pages, and Attachment 1.

This permit shall become effective on September 1, 1989.

This permit and the authorization to discharge shall expire at midnight, July 31, 1994.

July 18, 1989
Date Signed

Bruce R. Barrett, Director
Water Management Division

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall serial number 001 - Cooling pond discharge.

Such discharges shall be limited and monitored by the permittee as specified below:

PARAMETER	DISCHARGE LIMITATIONS	MONITORING REQUIREMENTS	
	Instantaneous Maximum	Measurement Frequency	Sample Type
Discharge Temperature, °F	92.0 1/	1/Day of Discharge 2/	Grab

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored at the edge of the FDER-granted mixing zone 1/day of discharge by a grab sample.

The maximum water surface elevation in the cooling pond shall be used as an indicator for discharge. Authorization for operation of 31 feet MSL maximum has been given by the South Florida Water Management District.

This discharge is permitted only in cases caused by extreme or cumulative rainfall in excess of the 10 year twenty-four hour hydrologic event, where unavoidable to prevent loss of life, severe property damage, or damage to the physical integrity of the cooling pond or its structures, and twice each year to test emergency release gates.

In the event a discharge occurs, including semiannual testing, permittee shall inform the Director, Water Management Division, Environmental Protection Agency (EPA) and the State Director by telephone as soon as practicable, but in no case later than 48 hours after the discharge occurs. Permittee shall also provide EPA and the State with the following information, in writing, within ten (10) days of the discharge:

a. A description and cause of the discharge; and
b. The period of discharge, including exact dates and times; and the anticipated time the discharge is expected to continue.

The permittee shall take all reasonable steps to minimize any adverse impact to navigable waters resulting from the discharge, including such monitoring as necessary to determine the environmental impact of the discharge. Monitoring shall include those parameters required in Part III-E. for the "spillway area" and shall be collected during each discharge.

CONTINUED

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall serial number 001 - Cooling pond discharge (CONTINUED).

Discharge of pollutants resulting from chlorination of once-through cooling water is prohibited.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

1/ The discharge temperature limitation shall apply at the edge of the FDEK-granted mixing zone (MZ). This MZ is defined as extending 800 meters from the spillway gates.

2/ Discharge temperature shall be monitored (but not limited) at the overflow point as well as the edge of the MZ.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

2. During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall serial number 002 - Point source(s) of surface runoff and cooling pond seepage to the St. Lucie Canal.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Daily Average	Daily Maximum	Measurement Frequency	Sample Type
Flow, MGD	Report	Report	1/Week	Totalizer

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored by a grab sample on a once-per-month basis.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): flow shall be a weekly totalized value from sumps 2 through 9 and 28, and calculated flows over weirs a, b, and c in the area of the pump station.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

3. During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall serial number 003 - Point source(s) of surface runoff and cooling pond seepage to L-65 Canal.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Daily Average	Daily Maximum	Measurement Frequency	Sample Type
Flow, MGD	Report	Report	1/Week	Totalizer

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored by a grab sample on a once-per-month basis.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): flow shall be a weekly totalized value from sumps 11 through 21.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

4. During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall serial number 004 1/ - Plant waste treatment system discharge.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	30-Day Average	Daily Maximum	Measurement Frequency	Sample Type
Flow, MGD	Report	Report	1/Month	Calculated
Oil and Grease, mg/l	15.0	20.0	1/Month	Grab
Total Suspended Solids, mg/l	30.0	100.0	1/Month	8 Hr. Composite

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Waste treatment system discharge prior to mixing with other waste streams or the receiving waters.

1/ Serial number assigned at an internal point for identification and monitoring purposes.

B. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

   Operational Level Attained . . . . Effective Date of Permit

2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

Part II

STANDARD CONDITIONS FOR NPDES PERMITS

SECTION A. GENERAL CONDITIONS

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

2. Penalties for Violations of Permit Conditions

Any person who violates a permit condition is subject to a civil penalty not to exceed $25,000 per day of such violation. Any person who willfully violates permit conditions is subject to a fine of not less than $5000 nor more than $50,000 per day of violation, or by imprisonment for not more than 3 years, or both. Any person who negligently violates permit conditions is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

3. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

4. Permit Modification

After notice and opportunity for a hearing, this permit may be modified, terminated, or revoked for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts;

c. A change in any conditions that requires either temporary interruption or elimination of the permitted discharge; or

d. Information newly acquired by the Agency indicating the discharge poses a threat to human health or the environment.

If the permittee believes that any past or planned activity would be cause for modification or revocation and reissuance under 40 CFR 122.62, the permittee must report such information to the Permit Issuing Authority. The submittal of a new application may be required of the permittee. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

5. Toxic Pollutants

Notwithstanding Paragraph A-4, above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation of such pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the permittee so notified.

6. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" Section B, Paragraph B-3, and "Upsets" Section B, Paragraph B-4, nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

8. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Property Rights

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

10. Onshore or Offshore Construction

.' 's permit does not authorize or approve the construction of any onshore o. offshore physical structures or facilities or the undertaking of any work in any waters of the United States

11. Severability

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

12. Duty to Provide Information

The permittee shall furnish to the Permit Issuing Authority, within a reasonable time, any information which the Permit Issuing Authority may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the Permit Issuing Authority upon request, copies of records required to be kept by this permit.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

' e permittee shall at all times properly operate and maintain all .acilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Need to Halt or Reduce not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the condition of this permit.

3. Bypass of Treatment Facilities

a. Definitions

(1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility, which is not a designed or established operating mode for the facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass not exceeding limitations.

The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Paragraphs c. and d. of this section.

c. Notice

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass; including an evaluation of the anticipated quality and effect of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Section D, Paragraph D-8 (24-hour notice).

d. Prohibition of bypass

(1) Bypass is prohibited and the Permit Issuing Authority may take enforcement action against a permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied in adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(c) The permittee submitted notices as required under Paragraph c. of this section.

(2) The Permit Issuing Authority may approve an anticipated bypass, after considering its adverse effects, if the Permit Issuing Authority determines that it will meet the three conditions listed above in Paragraph d.(1) of this section.

4. Upsets

"Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventive maintenance, or careless or improper operation. An upset constitutes an affirmative defense to an action brought for non-compliance with such technology based permit limitation if the requirements of 40 CFR 122.41(n)(3) are met.

5. Removed Substances

This permit does not authorize discharge of solids, sludge, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters of the United States unless specifically limited in Part 1.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative f the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Permit Issuing Authority.

2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to insure the accuracy and liability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to insure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10% from the true discharge rates throughout the range of expected discharge volumes. Once-through condenser cooling water flow which is monitored by pump logs, or pump hour meters as specified in Part I of this permit and based on the manufacture's pump curves shall not be subject to this requirement. Guidance in selection,installation, calibration, and operation of acceptable flow measurement devices can be obtained from the following references:

(1) "A Guide of Methods and Standards for the Measurement of Water Flow", U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 421, May 1975, 97 pp. (Available from the U.S. Government Printing Office, Washington, D.C. 20402. Order by SD catalog No. C13.10:421.)

(2) "Water Measurement Manual", U.S. Department of Interior, Bureau of Reclamation, Second Edition, Revised Reprint, 1974, 327 pp. (Available from the U.S. Government Printing Office, Washington, D.C. 20402. Order by catalog No. 127.19/2:W29/2, Stock No. S/N 24003-0027.)

(3) "Flow Measurement in Open Channels and Closed Conduits", U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 484, October 1977, 982 pp. (Available in paper copy or microfiche from National Technical Information Service (NTIS), Springfield, VA 22151. Order by NTIS No.PB-273 535/5ST.)

(4) "NPDES Compliance Flow Measurement Manual", U.S. Environmental Protection Agency, Office of Water Enforcement, Publication MCD-77, September 1981, 135 pp. (Available from the General Services Administration (8BRC), Centralized Mailing Lists Services, Building 41, Denver Federal Center, Denver, CO 80255.)

3. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

4. Penalties for Tampering

. a Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or both.

5. Retention of Records

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by the Permit Issuing Authority at any time.

6. Record Contents

Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;

b. The individual(s) who performed the sampling of measurements;

c. The date(s) analyses were performed;

d. The individual(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of such analyses.

7. Inspection and Entry

The permittee shall allow the Permit Issuing Authority, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit.

c. Inspect at reasonable time any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

SECTION D. REPORTING REQUIREMENTS

1. Change in Discharge

The permittee shall give notice to the Permit Issuing Authority as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source; or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under Section D, Paragraph D-10(a).

2. Anticipated Noncompliance

The permittee shall give advance notice to the Permit Issuing Authority of any planned change in the permitted facility or activity which may result in noncompliance with permit requirements. Any maintenance of facilities, which might necessitate unavoidable interuption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Permit Issuing Authority.

3. Transfer of Ownership or Control

A permit may be automatically transferred to another if:

a. The permittee notifies the Permit Issuing Authority of the proposed transfer at least 30 days in advance of the proposed transfer date;

b. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

c. The Permit Issuing Authority does not notify the existing permittee of his or her intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph b.

4. Monitoring Reports

See Part III of this permit.

5. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report (DMR). Such increased frequency shall also be indicated.

6. Averaging of Measurements

Calculations for limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Permit Issuing Authority in the permit.

7. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

Twenty-Four Hour Reporting

The permittee shall orally report any noncompliance which may endanger health or the environment, within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause, the period of noncompliance, including the exact dates and times; and if the noncompliance has not been corrected, the anticipated time it is expected to continue, and steps taken or planned to reduce, eliminate, and prevent reoccurance of the noncompliance. The Permit Issuing Authority may verbally waive the written report, on a case-by-case basis, when the oral report is made.

The following violations shall be included in the 24 hour report when they might endanger health or the environment:

a. An unanticipated bypass which exceeds any effluent limitation in the permit.

b. Any upset which exceeds any effluent limitation in the permit.

9. <u>Other Noncompliance</u>

The permittee shall report in narrative form, all instances of noncompliance not previously reported under Section D, Paragraphs D-2, D-4, D-7, and D-8 at the time monitoring reports are submitted. The reports shall contain the information listed in Paragraph D-8.

10. <u>Changes in Discharges of Toxic Substances</u>

The permittee shall notify the Permit Issuing Authority as soon as it knows or has reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant (listed at 40 CFR 122, Appendix D, Table II and III) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) One hundred micrograms per liter (100 ug/l);

(2) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony; or

(3) Five (5) times the maximum concentration value reported for that pollutant(s) in the application.

b. That any activity has occurred or will occur which would result in any discharge, on a routine or infrequent basis, of a toxic pollutant (listed at 40 CFR 122, Appendix D. Table II and III) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) Five hundred micrograms per liter (500 ug/l);

(2) One milligram per liter (1 mg/l) for antimony; or

(3) Ten (10) times the maximum concentration value reported for that pollutant(s) in the permit application.

11. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application should be submitted at least 180 days before the expiration date of this permit. The Permit Issuing Authority may grant permission to submit an application less than 180 days in advance but not later than the permit expiration date.

Where EPA is the Permit Issuing Authority, the terms and conditions of this permit are automatically continued in accordance with 40 CFR 122.6, only where the permittee has submitted a timely and complete application for a renewal permit and the Permit Issuing Authority is unable through no fault of the permittee to issue a new permit before the expiration date.

12. Signatory Requirements

All applications, reports, or information submitted to the Permit Issuing Authority shall be signed and certified.

a. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this Section, a responsible corporate officer means: (1) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or (2) the manager of one or more manufacturing production facilities employing more than 250 persons or having gross annual sales or expenditures exceeding 25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

b. All reports required by the permit and other information requested by the Permit Issuing Authority shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described above;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.); and

(3) The written authorization is submitted to the Permit Issuing Authority.

c. Certification. Any person signing a document under paragraphs (a) or (b) of this section shall make the following certification:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

13. Availability of Reports

Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Permit Issuing Authority. As required by the Act, permit applications, permits and effluent data shall not be considered confidential.

14. Penalties for Falsification of Reports

The Clean Water Act provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, or who knowingly falsifies, tampers with, or renders inaccurate any monitoring device or method required to be maintained under the Clean Water Act, shall, upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than 2 years, or both.

SECTION E. DEFINITIONS

1. Permit Issuing Authority

The Regional Administrator of EPA Region IV or his designee, unless at some time in the future the State receives authority to administer the NPDES program and assumes jurisdiction over the permit; at which time, the Director of the State program receiving the authorization becomes the issuing authority.

2. Act

"Act" means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) Public Law 92-500, as amended by Public Law 95-217 and Public Law 95-576, 33 U.S.C. 1251 et seq.

3. Mass/Day Measurements

a. The "average monthly discharge" is defined and the total mass of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such month. It is therefore, and arithmetic mean found by adding the weights of the pollutant found each day of the month and then dividing this sum by the number of days the tests were reported. The limitation is identified as "Daily Average" or "Monthly Average" in Part I of the permit and the average monthly discharge value is reported in the "Average" column under "Quantity" on the Discharge Monitoring Report (DMR).

b. The "average weekly discharge" is defined as the total mass of all daily discharges sampled and/or measured during the calendar week on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such week. It is, therefore, an arithmetic mean found by adding the weights of pollutants found each day of the week and then dividing this sum by the number of days the tests were reported. This limitation is identified as "Weekly Average" in Part I of the permit and the average weekly discharge value is reported in the "Maximum" column under "Quantity" on the DMR.

c. The "maximum daily discharge" is the total mass (weight) of a pollutant discharged during a calendar day. If only one sample is taken during any calendar day the weight of pollutant calculated from it is the "maximum daily discharge". This limitation is identified as "Daily Maximum", in Part I of the permit and the highest such value recorded during the reporting period is reported in the "Maximum" column under "Quantity" on the DMR.

d. The "average annual discharge" is a rolling average equal to the arithmetic mean of the mass measured in all discharges sampled and/or measured during consecutive reporting periods which comprise one year. For parameters that are measured at least once per month, the annual average shall be computed at the end of each month and is equal to the arithmetic mean of the monthly average of the month being reported and the monthly average of each of the previous eleven months. This limitation is defined as "Annual Average" in Part I of the permit and the average annual discharge value is reported in the "Average" column under "Quantity" on the DMR.

4. Concentration Measurements

a. The "average monthly concentration", other than for fecal coliform bacteria, is the sum of the concentrations of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such month (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or in the case of grab samples is the arithmetic mean (weighted by flow value) of all the samples collected during that calendar day. This limitation is identified as "Monthly Average" or "Daily Average" under "Other Limits" in Part I of the permit and the average monthly concentration value is reported under the "Average" column under "Quality" of the DMR.

b. The "average weekly concentration", other than for fecal coliform bacteria, is the sum of the concentrations of all daily discharges sampled and/or measured during a calendar week on which daily discharges are sampled and measured divided by the number of daily discharges sampled and/or measured during such week (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or in the the case of grab samples is the arithmetic mean (weighted by flow value) of all the samples collected during that calendar day. This limitation is identified as "Weekly Average" under "Other Limits" in Part I of the permit and the average weekly concentration value is reported under the "Maximum" column under "Quality" on the DMR.

c. The "maximum daily concentration" is the concentration of a pollutant discharged during a calendar day. It is identified as "Daily Maximum" under "Other Limits" in Part I of the permit and the highest such value recorded during the reporting period is reported under the "Maximum" column under "Quality" on the DMR.

d. The "average annual concentration", other than for fecal coliform bacteria, is a rolling average equal to the arithmetic mean of the effluent or influent samples collected during consecutive reporting periods which comprise one year. For parameters that are measured at least once per month, the annual average shall be computed at the end of each month and is equal to the arithmetic mean of the monthly average of the month being reported and the monthly average of each of the previous eleven months. This limitation is identified as "Annual Average" under "Other Limits" in Part I of the permit and the average annual concentration value is reported under the "Average" column under "Quality" on the DMR.

5. <u>Other Measurements</u>

a. The effluent flow expressed as million gallons per day (MGD) is the 24 hour average flow averaged monthly. It is the arithmetic mean of the total daily flows recorded during the calendar month. Where monitoring requirements for flow are specified in Part I of the permit the flow rate values are reported in the "Average" column under "Quantity" on the DMR.

b. An "instantaneous flow measurement" is a measure of flow taken at the time of sampling, when both the sample and flow will be representative of the total discharge.

c. Where monitoring requirements for pH, dissolved oxygen or fecal coliform bacteria are specified in Part I of the permit, the values are generally reported in the "Quality or Concentration" column on the DMR.

d. The "average annual discharge" for fecal coliform bacteria shall be calculated in the same manner as that for mass limitations (see item II.E.3.d.).

6. Types of Samples

a. Composite Sample: A "composite sample" is a combination of not less than 8 influent or effluent portions, of at least 100 ml, collected over the full time period specified in Part I.A. The composite sample must be flow proportioned by either time interval between each aliquot or by volume as it relates to effluent flow at the time of sampling or total flow since collection of the previous aliquot. Aliquots may be collected manually or automatically.

b. Grab Sample: A "grab sample" is a single influent or effluent portion which is not a composite sample. The sample(s) shall be collected at the period(s) most representative of the total discharge.

7. Calculation of Means

a. Arithmetic Mean: The "arithmetic mean" of any set of values is the summation of the individual values divided by the number of individual values.

b. Geometric Mean: The "geometric mean" of any set of values is the N^{th} root of the product of the individual values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered to be one (1).

c. Weighted by Flow Value: "Weighted by flow value" means the summation of each concentration times its respective flow divided by the summation of the respective flows.

8. Calendar Day

A "calendar day" is defined as the period from midnight of one day until midnight of the next day. However, for purposes of this permit, any consecutive 24-hour period that reasonably represents the calendar day may be used for sampling.

9. Hazardous Substance

A "hazardous substance" means any substance designated under 40 CFR Part 116 pursuant to Section 311 of the Clean Water Act.

10. Toxic Pollutants

A "toxic pollutant" is any pollutant listed as toxic under Section 307(a)(1) of the Clean Water Act.

PART III

OTHER REQUIREMENTS

A. Reporting of Monitoring Results

Monitoring results obtained for each calendar month shall be summarized for that month and reported on a Discharge Monitoring Report Form (EPA No. 3320-1), postmarked no later than the 28th day of the month following the completed calendar month. (For example, data for January shall be submitted by February 28.) Duplicate signed copies of these, and all other reports required by Section D of Part II, Reporting Requirements, shall be submitted to the Permit Issuing Authority and the State at the following addresses:

Environmental Protection Agency
Region IV
Water Management Division
Facilities Performance Branch
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Florida Dept. of Environmental Regulation
Southeast District Office
1900 S. Congress Avenue, Suite A
Post Office Box 3858
West Palm Beach, Florida 33406

B. There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

C. The company shall notify the Director in writing not later than six (6) months prior to instituting use of any cooling water biocide or chemical which may be toxic to aquatic life. Such notification shall include:

1. Name and general composition of biocide or chemical.
2. Frequency of use.
3. Quantities used.
4. Proposed effluent concentration.
5. EPA registration number, if applicable.

D. Discharge of any product registered under the Federal Insecticide, Fungicide, and Rodenticide Act to any wastestream which may ultimately be released to lakes, rivers, streams, or other waters of the United States is prohibited unless specifically authorized elsewhere in this permit. This requirement is not applicable to products used for lawn and agricultural purposes. Use of chlorine gas, sodium hypochlorite, or other similar chlorine compounds for disinfection in plant potable and service water systems and in sewage treatment is authorized.

Herbicides may be used within the cooling pond for the purpose of prevention of over accumulation of aquatic weeds that could inhibit cooling pond water circulation. Use shall be in accordance with labeled instructions. Not later than ninety (90) days after the effective date of this permit, the permittee shall provide the Director with a listing of all herbicides used in the previous twelve (12) months. Other products shall not be used without prior approval.

E. The cooling pond shall be monitored as indicated below. Reports shall be submitted to the Director, Water Management Division, and the State Director on a monthly basis with the report submitted no later than thirty days after the month for which analyses were required. The following parameters shall be tested for at the start of the discharge and daily thereafter until the discharge is discontinued: pH, flow, dissolved oxygen, and discharge temperature. The following parameters shall be tested for at the start of the discharge and weekly thereafter until the discharge is discontinued: total dissolved solids, chlorides, copper, iron, sulfate, ammonia, total nitrogen, total phosphate, silver, and zinc. (If pH is either below 6.0 or above 8.5 standard units, pH must be measured at the boundary of the Florida Department of Environmental Regulation (FDER)-granted mixing zone every five hours during daylight hours until the discharge is discontinued. If any other of the aforementioned parameters of the effluent exceed the FDER Class III Surface Waters standards, those parameters shall be monitored at the boundary of the FDER-granted mixing zone during the next spillway release.)

F. Reopener Clause

This permit shall be modified or, alternatively, revoked and reissued to comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) of the Clean Water Act (the Act), as amended, if the effluent standard or limitation so issued or approved:

a. Contains different conditions or is otherwise more stringent than any condition in the permit; or

b. Controls any pollutant not addressed in the permit.

The permit as modified or reissued under this paragraph shall contain any other requirements of the Act then applicable.

G. The permittee shall report all visible discharges of floating materials, such as ash or an oil sheen, to the Director when submitting DMR's. Field data sheets shall have appropriate blank(s) to report observations.

H. Equivalent Waste Treatment Assessment

In order to provide continued assurance that the plant waste treatment system (PWTS), in conjunction with further treatment in the cooling pond, is providing equivalent treatment for total iron, total copper, and other pollutants in nonchemical metal cleaning waste (NCMCW), the permittee shall evaluate the treatment provided by the PWTS during the next typical NCMCW treatment period. Analyses shall include soluble and total copper, manganese, iron, and zinc in individual NCMCW components (i.e., economizer hopper wash, dust collector wash, boiler fireside wash, air preheater wash, and stack wash) and in the final effluent over the entire period of waste generation, treatment, and discharge. Evaluation shall include the total quantity and average concentration of each of the above metals (both soluble and total) produced in each NCMCW component and in the final effluent. Sampling, analysis, and evaluation at internal points in the treatment process may be included at the permittee's discretion. Within 90 days of completion of the cleaning, a report assessing the assessment results shall be submitted. In the event that the Director finds that the data do not support continuation of the equivalency determination, he may require additional testing or appropriately modify the permit.

I. <u>Chemical Metal Cleaning Waste Discharge</u>

Except for chemical metal cleaning operations in which CITRO-SOLV or an equivalent cleaner is used and the chemical metal cleaning waste (CMCW) is burned in an operating unit, there shall be no discharge of CMCW to any waste stream which ultimately discharges to waters of the United States.

After the initial use of each cleaning product, the permittee shall determine the flow of CMCW produced and monitor the effluent for a range of heavy metals, including total and dissolved iron, copper, nickel, and zinc, prior to and during discharge. This is to assure that metals are not being discharged in excess of the guideline limitations and the previous equivalency determination.

J. Discharge of intake screen backwash to the plant intake canal is permitted without limitation or monitoring requirements, except that there may be no discharge of a visible oil sheen.

PART IV

BEST MANAGEMENT PRACTICES CONDITIONS

SECTION A. GENERAL CONDITIONS

1. BMP Plan

For purposes of this part, the terms "pollutant" or "pollutants" refer to any substance listed as toxic under Section 307(a)(1) of the Clean Water Act, oil, as defined in Section 311(a)(1) of the Act, and any substance listed as hazardous under Section 311 of the Act. The permittee shall develop and implement a Best Management Practices (BMP) plan which prevents, or minimizes the potential for, the release of pollutants from ancillary activities, including material storage areas; plant site runoff; in-plant transfer, process and material handling areas; loading and unloading operations, and sludge and waste disposal areas, to the waters of the United States through plant site runoff; spillage or leaks; sludge or waste disposal; or drainage from raw material storage.

2. Implementation

The plan shall be developed within six months after the effective date of this permit and shall be implemented as soon as practicable but not later than 18 months after the effective date of this permit condition unless a later date is specified by the Director.

3. General Requirements

The BMP plan shall:

a. Be documented in narrative form, and shall include any necessary plot plans, drawings or maps.

b. Establish specific objectives for the control of pollutants.

(1) Each facility component or system shall be examined for its potential for causing a release of significant amounts of pollutants to waters of the United States due to equipment failure, improper operation, natural phenomena such as rain or snowfall, etc.

(2) Where experience indicates a reasonable potential for equipment failure (e.g., a tank overflow or leakage), natural condition (e.g., precipitation), or other circumstances to result in significant amounts of pollutants reaching surface waters, the plan should include a prediction of the direction, rate of flow, and total quantity of pollutants which could be discharged from the facility as a result of each condition or circumstance.

c. Establish specific best management practices to meet the objectives identified under paragraph b of this section, addressing each component or system capable of causing a release of significant amounts of pollutants to the waters of the United States, and identifying specific preventative or remedial measures to be implemented.

d. Include any special conditions established in Section B of this part.

e. Be reviewed by plant engineering staff and the plant manager.

4. Documentation

The permittee shall maintain the BMP plan at the facility and shall make the plan available to the permit issuing authority upon request.

5. BMP Plan Modification

The permittee shall amend the BMP plan whenever there is a change in the facility or change in the operation of the facility which materially increases the potential for the ancillary activities to result in a discharge of significant amounts of pollutants.

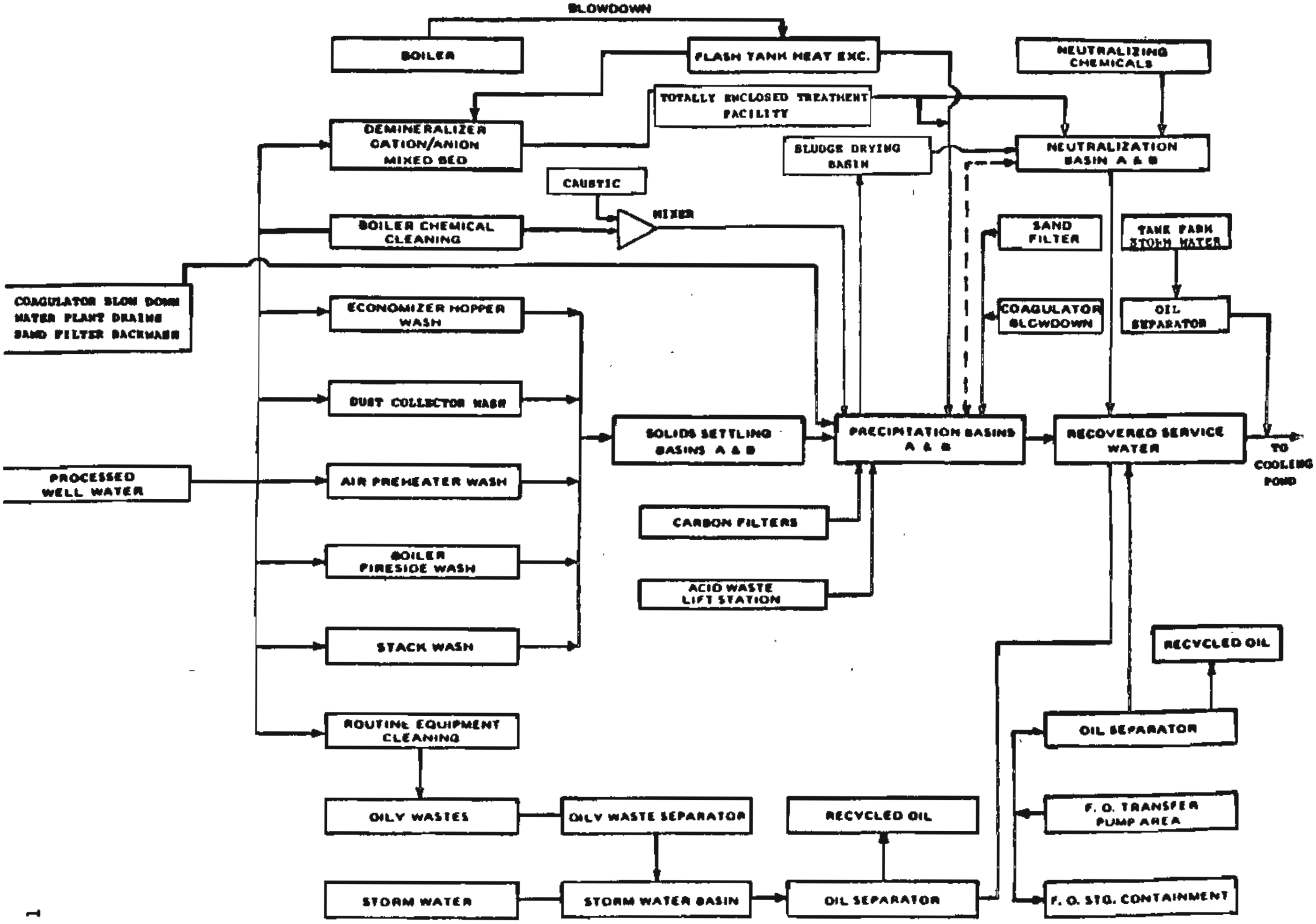
6. Modification for Ineffectiveness

If the BMP plan proves to be ineffective in achieving the general objective of preventing the release of significant amounts of pollutants to surface waters and the specific objectives and requirements under paragraphs b and c of Section 3, the permit shall be subject to modification pursuant to 40 CFR 122.62 or 122.63 to incorporate revised BMP requirements. Any such permit modification shall be subject to review in accordance with the procedures for evidentiary hearings set forth in 40 CFR Part 124.

SECTION B. SPECIAL CONDITIONS

NONE.

Best Available Copy



MARTIN PLANT WASTE SYSTEM FLOW DIAGRAM

ATTACHMENT 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

DATE: June 30, 1989

AMENDMENT TO THE FACT SHEET AT THE TIME OF FINAL PERMIT ISSUANCE

APPLICATION NUMBER: FL0030988

NAME OF APPLICANT: Florida Power and Light Company
Martin Steam Plant

1. Changes to Permit from Draft Permit to Final Permit Stage

Cover Page

Revision was made based on facility comments. The number of pages in Part I is changed to 6 to reflect the deletion of serial number 005.

Page I-1

Revisions were made in response to facility comments. The maximum water surface elevation in the cooling pond is to be used as an indicator for discharge. The authorization, which has been given by the South Florida Water Management District, for operation at 31 feet MSL maximum is referenced.

Page I-5

Revision was made in accordance with facility's comments. The restriction on discharge of floating solids and visible foam is deleted due to inapplicability to internal wastestreams.

Page I-6

Revision was made in accordance with facility's comments. The serial number 005 is deleted from the permit based on a best professional judgement which indicates that stormwater discharges from diked petroleum storage or handling areas will be adequately addressed by the requirements of Part IV of the permit and the implementation of best management practices.

Page I-7

Revision was made in response to facility comments. The page is renumbered to reflect the deletion of serial number 005.

Page III-1

Revisions were made in accordance with facility's comments. Authorization of the use of herbicides within the cooling pond for the purpose of aquatic weed control is specifically addressed.

Provision F was revised to exclude a portion relating to reopening of the permit based on changes in the State-issued permit. This decision was based on a determination that the language did not explicitly describe the regulatory procedural requirements of 40 C.F.R. Section 124.55(b). Because 40 C.F.R. Sections 122.62 and 124.5 provide for modification of the NPDES permit, it was determined that the provision was not necessary to the permit and that it should be removed.

Page III-2

Provision E was revised in accordance with the facility's comments. Total residual chlorine was determined to be erroneously included in the parameters to be monitored and is deleted. The parameters included in the requirement for monitoring at the boundary of an FDER-granted mixing zone were determined to be erroneously cited and are changed to be limited to those addressed in the FDER-issued permit.

Provision G was revised based on facility comments. In accordance with a best professional judgement, a provision is added to require recordkeeping of visible discharges of floating materials on field data sheets.

Page III-3

Page III-3 was revised to exclude provision J in accordance with a best professional judgement. This decision was based on a determination that the language did not explicitly describe the regulatory procedural requirements of 40 C.F.R. Section 124.55(b). Because 40 C.F.R. Section 124.55(b) sets out the effect of a change to a state certification and 40 C.F.R. Sections 122.62 and 124.5 provide for modification of the NPDES permit, it was determined that the provision was not necessary to the permit and that it should be removed.

Revisions to Page III-3 were then made in accordance with facility's comments. Specifically, per indication of a best professional judgement, provision J is added to authorize the discharge of ' intake screen backwash without limitation or monitoring requirements, except for a restriction on discharge of visible oil sheen.

Fact Sheet

Pages 3 and 5 of the fact sheet were revised based on facility comments. Per a best professional judgement, reference to serial number 005 is deleted from these pages. (See information concerning Page I-6 above.)

2. Public Comment

No public comments were received.

3. State Certification

State certification was requested on April 6, 1989. State certification was waived per correspondence dated May 24, 1989.

REQUIREMENTS FOR EVIDENTIARY/PANEL HEARING REQUEST

Evidentiary Hearing (40 CFR 124.74)

(a) Within 30 days following service of notice of the Regional Administrator's final permit decision under 124.15 any interested person may submit a request to the Regional Administrator under paragraph (b) of this section for an evidentiary hearing to reconsider or contest that decision. If such a request is submitted by a person other than the permittee, the person shall simultaneously serve a copy of the request on the permittee.

(b) (1) In accordance with 124.76, such requests shall state each legal or factual question alleged to be at issue, and their relevance to the permit decision, together with a designation of the specific factual areas to be adjudicated and the hearing time estimated to be necessary for adjudication. Information supporting the request or other written documents relied upon to support the request shall be submitted as required by 124.73 unless they are already part of the administrative record required by 124.18.

'ote: This paragraph allows the submission of requests for evidentiary hearings even though both legal and factual issues may be raised, or only legal issues may be raised. In the latter case, because no factual issues were raised, the Regional Administrator would be required to deny the request. However, on review of the denial the Administrator is authorized by 124.91(a)(1) to review policy or legal conclusions of the Regional Administrator. EPA is requiring an appeal to the Administrator even of purely legal issues involved in a permit decision to ensure that the Administrator will have an opportunity to review any permit before it will be final and subject to judicial review.

(2) Persons requesting an evidentiary hearing on an NPDES permit under this section may also request an evidentiary hearing on a RCRA or UIC permit, PSD permits may never be made part of an evidentiary hearing under Subpart E. This request is subject to all the requirements of paragraph (b)(1) of this section and in addition will be granted only if:

(i) Processing of the RCRA or UIC permit at issue was consolidated with the processing of the NPDES permit as provided in 124.4;

(ii) The standards for granting a hearing on the NPDES permit are met;

(iii) The resolution of the NPDES permit issues is likely to make necessary or appropriate modification of the RCRA or UIC permit; and

(iv) If a PSD permit is involved, a permittee who is eligible for an evidentiary hearing under Subpart E on his or her NPDES permit requests that the formal hearing be conducted under the procedures of Subpart F and the Regional Administrator finds that consolidation is unlikely to delay final permit issuance beyond the PSD one-year statutory deadline.

(c) These requests shall also contain:

(1) The name, mailing address, and telephone number of the person making such request;

(2) A clear and concise factual statement of the nature and scope of the interest of the requester;

(3) The names and addresses of all persons whom the requester represents; and

(4) A statement by the requester that, upon motion of any party granted by the Presiding Officer, or upon order of the Presiding Officer <u>sua sponte</u> without cost or expense to any other party, the requester shall make available to appear and testify, the following:

(i) The requester;
(ii) All persons represented by the requester: and
(iii) All officers, directors, employees, consultants, and agents of the requester and the persons represented by the requester.

(5) Specific references to the contested permit conditions, as well as suggested revised or alternative permit conditions (including permit denials) which, in the judgement of the requester, would be required to implement the purposes and policies of the CWA.

(6) In the case of challenges to the application of control or treatment technologies identified in the statement of basis or fact sheet, identification of the basis for the objection, and the alternative technologies or combination of technologies which the requester believes are necessary to meet the requirements of the CWA.

(7) Identification of the permit obligations that are contested or are inseverable from contested conditions and should be stayed if the request is granted by reference to the particular contested conditions warranting the stay.

(8) Hearing requests also may ask that a formal hearing be held under the procedures set forth in Subpart F. An applicant may make such a request even if the proceeding does not constitute "initial licensing" as defined in 124.111.

(d) If the Regional Administrator grants an evidentiary hearing request in whole or in part, the Regional Administrator shall identify the permit conditions which have been contested by the requester and for which the evidentiary hearing has been granted. Permit conditions which are not contested or for which the Regional Administrator has denied the hearing request shall not be affected by, or considered at, the evidentiary hearing. The Regional Administrator shall specify these conditions in writing in accordance with 124.60(c).

(e) The Regional Administrator must grant or deny all requests for an evidentiary hearing on a particular permit. All requests that are granted for a particular permit shall be combined in a single evidentiary hearing.

(f) The Regional Administrator (upon notice to all persons who have already submitted hearing requests) may extend the time allowed for submitting hearing requests under this section for good cause.

FPL

P. O. Box 078768, West Palm Beach, FL 33407-0768
6001 Village Blvd.

December 11, 1989

Mr. W. Ray Cunningham, Director
Water Management Division
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, GA 30365

FPL-JEN-WMD-170-89-53

RE: MARTIN STEAM PLANT NPDES NO. FL0030988
REQUEST FOR MODIFICATION OF PERMIT

Dear Mr. Cunningham:

The EPA previously has been informed that FPL plans to add four combined cycle generating units and four coal gasification plants to its existing Martin Plant Site located near Indiantown, in Martin County, Florida. These additions will increase the generating capacity of the site from the existing 1600 MW (nominal) to approximately 3200 MW. FPL's request for a New Source Determination is pending. In view of that fact, we are submitting this request by letter. We believe that the Florida Power Plant Site Certification Application to be submitted within 30 days will provide additional information which EPA may require to modify the existing permit. In accordance with 40 CFR 122.62 (a) (1) which lists "Alterations" (i.e., material and substantial alterations or additions to the permitted facility) as a reason for modification, FPL requests that NPDES permit number FL0030988 be modified.

The wastewater treatment system for the added facilities is intended to provide treatment equivalent to any applicable effluent guidelines so that discharges to waters of the United States from the cooling pond will meet applicable effluent limits without effects of dilution and mixing that occur in the pond. After the additions to the Martin Plant Site are completed, the Cooling Pond Outfall (001) will still be the only direct surface water outfall from the Martin Plant Site. However, the chemical characteristics of the Cooling Pond Outfall and Cooling Pond Seepage, as measured at the other surface water outfalls (002 and 003), will change as a result of increased cycles of concentration within the cooling pond and a new release point to the pond from the combined cycle generating units.

Table 1 presents a summary of projected worst case water quality characteristics for the Cooling Pond releases and seepage. Although the worst case concentrations shown for total copper and total zinc are higher than their respective Florida Class III surface water quality criteria, ionic balance calculations have shown that both copper and zinc are not in forms which would make them available to biological uptake. In addition, releases to surface waters of the U.S. from the Cooling Pond occur only during twice annual spillway gate tests and during periods of unusually high rainfall which result in high Pond water elevations. Water quality of the Pond is monitored during gate tests to verify conformance with water quality standards. In the case of Pond releases as a result of excessive rainfall, the Pond would be diluted to an extent that any discharges would meet Class III criteria. Therefore, surface water discharges from the Cooling Pond are not expected to impact the water quality of the St. Lucie Canal.

Figure 1 illustrates the relative location of the existing and proposed generating units at the Martin Plant Site, the cooling pond, and the current NPDES serial numbered monitoring points.

As specified in the Federal Consistency Evaluation Procedures (15 CFR 930.50) all federal permits for which there are no analogous state permits require certification of compliance with approved Coastal Zone Management Programs. NPDES permits have no analogous State of Florida permit. Therefore, in accordance with the requirements of the Federal Consistency Evaluation Procedures, we are submitting as an attachment to this Request for Modification, a coastal management program consistency certification. As specified in 15 CFR 930.58, a copy of this permit modification request and the consistency certification have been sent under separate cover to the Federal Consistency Coordinator of the Florida State Planning and Development Clearinghouse.

Should you have any questions concerning the above, please contact Mr. Wayne Ondler at (407) 640-2042.

Sincerely,

Martin A. Smith, Ph.D.
Manager
Environmental Permitting & Programs

MAS:kw

Enclosures

TABLE 1

WORST CASE WATER QUALITY CHARACTERISTICS, MARTIN PLANT COOLING POND SPILLWAY RELEASES AND COOLING POND SEEPAGE

PARAMETER	COOLING POND[4] SPILLWAY RELEASES (mg/1)	COOLING POND SEEPAGE[2] (mg/1)
Aluminum	0.002	0.002
Ammonia	<0.02 (un-ionized)	<0.02 (un-ionized)
Antimony	0.004	0.004
Arsenic	0.0293	0.0293
Beryllium	0.0001	0.0001
Cadmium	0.0004	0.0004
Calcium	162.6	162.6
Chloride	332.9	332.9
Chromium	0.0035	0.0035
Copper	0.084[1]	<0.03[1][3]
Cyanide	0.002	0.002
Fluoride	0.048	0.048
Iron	<0.01[1]	<0.01[1]
Lead	0.0252	0.0252
Magnesium	44.5	44.5
Mercury	0.000051[1]	<0.000002[1]
Nickel	0.025	0.025
Nitrate	0.9	0.9
Nitrite	0.102	0.102
Phenol	0.00	0.00
Phosphate		
Ortho-	0.138	0.138
Total-	0.534	0.534
Potassium	16.803	16.803
Selenium	0.00006	0.00006
Silica	33.415	33.415
Sodium	216	216
Sulfate	243.5	243.5
Zinc	0.052[1]	<0.001[1]
Total Alkalinity	365.9	365.9
Total Hardness	573	573
pH	6.5-8.5	6.5-8.5
TDS	1327	1327
TSS	50	50
Flow	NA	NA

(1) Assumes chemical and physical removal.

(2) Worst case water quality of Pond Seepage, monitored at Serial Numbered Outfalls 002 and 003.

(3) Assumes some biological removal.

(4) Water quality will be monitored during discharge in semi-annual spillway gate tests to verify compliance with Florida Class III Surface Water Quality Criteria.

NA - Not applicable.

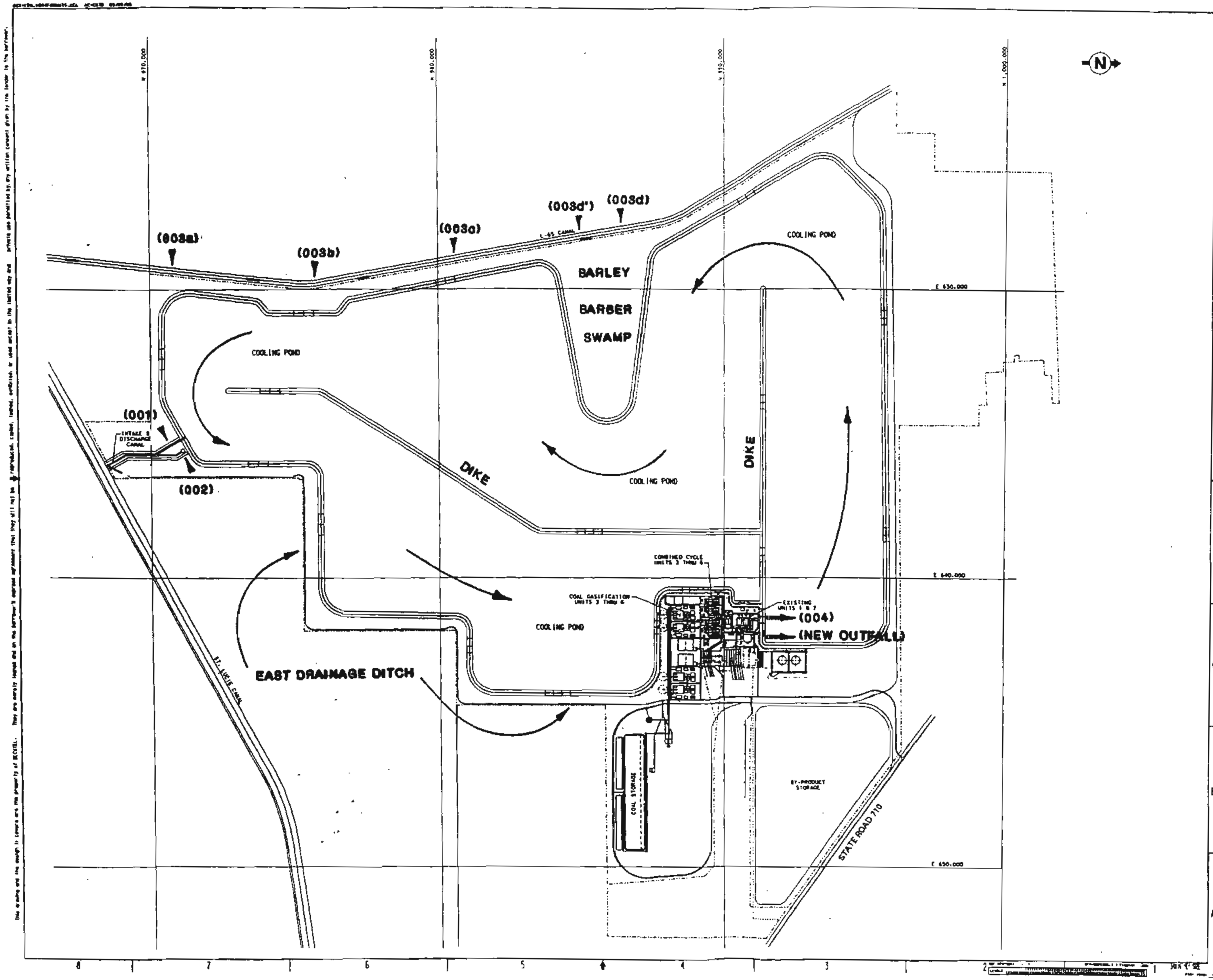


FIGURE 1

NPDES SERIAL OUTFALLS MARTIN CG/CC SITE

LEGEND

(000) SERIAL NUMBERED OUTFALL

FPL

Martin CG/CC Project

FPL

P. O. Box 078768, West Palm Beach, FL 33407-0768
6001 Village Blvd.

December 11, 1989

State Planning & Development Clearinghouse
Office of Planning and Budgets
Executive Office of the Governor
The Capitol
Tallahassee, Florida 32399-0001

FPL-JEN-SPD-170-89-54

Attention: Federal Consistency Coordinator

RE: FPL Martin CG/CC Plant
EPA-Coastal Zone Management Consistency Certification

Dear Sir:

In accordance with the Florida Coastal Management Program (FCMP) and the Federal Consistency Evaluation Procedures (15 CFR 930.50), all federal permits for which there are no analogous state permits require certification of compliance with the FCMP. A federal permit applicable to the referenced proposed project for which no analogous state permit exists is the U.S. Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Permit. In accordance with requirements of the Federal Consistency Evaluation Procedures, a request for modification of this permit must be accompanied by a consistency certification which includes:

- a written and pictorial description of the project;
- an assessment of probable impacts relevant to applicable FCMP statutes; and
- a signed statement by the applicant regarding consistency of the project with FCMP statutes.

As specified in 15 CFR 930.58, the certification package and request for permit modification must be sent to the appropriate federal agency (EPA) and to the Federal Consistency Coordinator of the Florida State Planning and Development Clearinghouse. Therefore, FPL is submitting the enclosed permit modification request and consistency certification package for it's Martin CG/CC Plant as required. The original request and certification package was sent to the EPA Regional Office in Atlanta for their review.

If you have any questions or require any additional information, please contact us at (407) 640-2040

Sincerely,

June M. Small
Manager
Environmental Resources and Planning

JMS:kw

FCMP CONSISTENCY CERTIFICATION
FPL MARTIN CG/CC PLANT

DESCRIPTION OF THE PROJECT

Florida Power & Light Company (FPL) proposes to construct a coal gasification/combined cycle (CG/CC) power plant adjacent to the existing 1600 MW Martin Plant near Indiantown, Florida.

The existing Martin Plant occupies a portion of the approximately 11,300 acre Martin Site, which consists of a 6,800 acre cooling pond and a 300 acre area containing the power block for Martin Units 1 and 2. These two units have been in operation since December 1980 and June 1981, respectively.

The proposed expansion project is designed for phased implementation of four nominal 400 MW combined cycle generating modules with coal gasification plant construction to follow combined cycle power plant development. The combined cycle power plants will consist of combustion turbines (CTs), heat recovery steam generators (HRSGs), steam turbines and switchyards. The expansion project will ultimately contain all the necessary facilities to convert coal into a low sulfur, medium Btu fuel gas and generate power from the cleaned fuel. Until the gasification plants are brought on line, natural gas will serve as the primary fuel for the CTs with No. 2 fuel oil as backup. The CG/CC project, including the coal gasification plants and other facilities, will require approximately 1,300 acres of the existing site. Figure 1 provides a layout for the proposed expansion project.

Assessment of Probable Project Impacts

As part of the Federal Consistency Evaluation Procedures, an assessment of the probable impacts of the project on the coastal zone were determined in relation to the Florida Coastal Management Program (FCMP) statutes.

Flood Zones - The Martin CG/CC Plant will be within Zone B (100 to 500 year flood plain area) as defined by flood insurance rate maps. All CG/CC facility building floor elevations will be at or above the 100 year flood elevation of 31 ft. NGVD. In addition, all CG/CC facilities will be designed to comply with all applicable South Florida Water Management District (SFWMD) and Florida Department of National Resources (FDNR) requirements regarding flood protection control. Installation and operation of the CG/CC facility is expected to have no adverse impact on the 100-year flood elevations or flood flows. Since the plant will be entirely above the limits of the 100 year flood, adjacent properties owners will not be adversely affected.

Air and Water Impacts - These concerns will be addressed by obtaining the appropriate facility operation and discharge permits and using pollution control measures to abate impacts from facility construction and operations. Air construction and operation permits will be obtained through the Power Plant Siting Act process in accordance with requirements established in the Prevention of Significant Air Quality Deterioration (PSD) regulations and the regulation governing New Sources. The existing wastewater discharge permit (NPDES) will be modified according to the needs of the new facility.

Stormwater retention basins will be used to collect runoff waters from the site. The discharge from these basins will comply with all DER and South Florida Water Management District requirements for protection of surface and ground-water.

Archeological and Historical Resources Impacts - The Florida Division of Archives, History and Records Management has stated that there are no known or potential historical or archeological resources at the site. Therefore, no significant cultural resources will be affected by the construction or operation of the project.

Water Resource Impacts - The South Florida Water Management District (SFWMD) will review the project for water resources impacts. Consumptive use of water is anticipated, therefore permits for such use will be obtained from SFWMD. Monitoring wells will be installed to provide an early warning system of groundwater contamination, and stormwater management practices will be employed to mitigate impacts to water resources from runoff.

Power Plant Siting Act (PPSA) - An application is being filed with the Florida Department of Environmental Regulation (FDER) under the Power Plant Siting Act. This application will present information discussing the conditions resulting from construction, and the anticipated impacts from facility operation, in order to provide assurance that all applicable state, regional and local standards are met and that the project will be consistent with the FCMP.

Consistency Determination

The proposed project complies with Florida's approved coastal management program and will be conducted in a manner consistent with such program.

June M. Small

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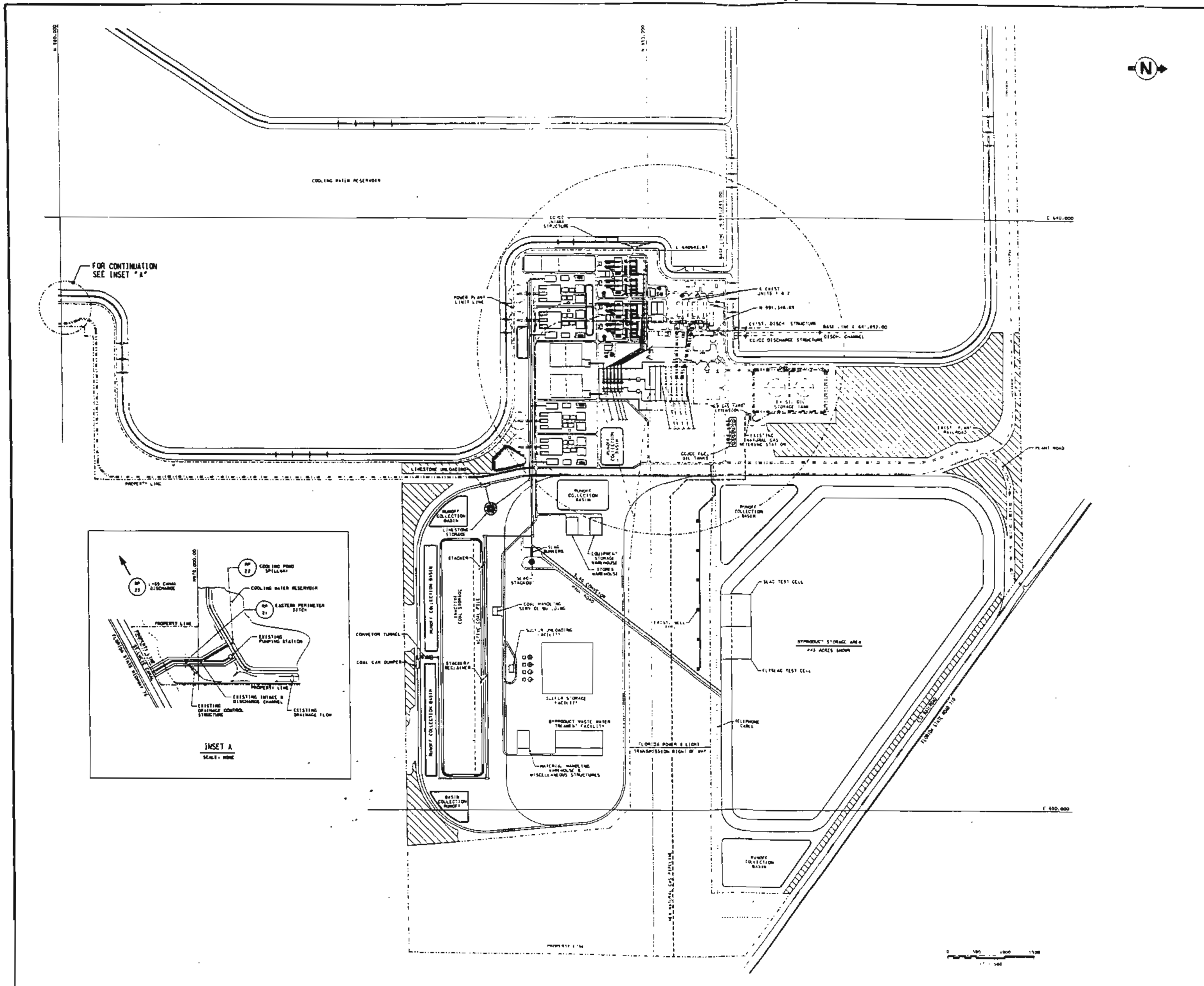

FIGURE 1

LAYOUT OF PROPOSED EXPANSION PROJECT

Martin CG/CC Project

FPL

10.1.3 HAZARDOUS WASTE DISPOSAL APPLICATIONS/PERMITS

No Federal or State applications for a hazardous waste permit will be made for the construction or operation of the Martin CG/CC Project (proposed). Following is a letter to the Environmental Administrator of the DER Bureau of Waste Planning & Regulation, Hazardous Waste Permitting Section, which explains why there is no need for such permit applications.

HOPPING BOYD GREEN & SAMS
ATTORNEYS AND COUNSELORS
123 SOUTH CALHOUN STREET
POST OFFICE BOX 6526
TALLAHASSEE, FLORIDA 32314
(904) 222-7500
FAX (904) 224-8551

November 1, 1989

BY HAND-DELIVERY

Mr. Satish Kastury
Environmental Administrator
Hazardous Waste Permitting Section
Bureau of Waste Planning & Regulation
Department of Environmental Regulation
Room 572D
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Florida Power and Light
Martin Plant Expansion Project
Martin County, Florida

Dear Satish:

On September 29, 1989, representatives of Florida Power and Light Company (FPL) and I met with members of the Department staff, including Robert Frost, Diane Hunt, and others. You were kind enough to suggest that the meeting should proceed although you were unable to attend because of an unexpected commitment elsewhere.

As I had mentioned to you by telephone in scheduling the meeting, the purpose was twofold: (1) to explain briefly FPL's plans for the construction of up to four additional electric generating units and coal gasification facilities at its existing power plant site in Martin County, and (2) to obtain concurrence from the Department that no hazardous waste permitting requirements would apply to the project if all hazardous waste management activities to be undertaken were carried out in accordance with applicable rules and regulations and in the manner described below.

The intent of this letter is briefly to confirm the results of our meeting and to ask for Department concurrence in the findings and conclusions which FPL believes were reached.

As a brief summary of the status of this FPL project, I would reiterate that the environmental licensing of this activity will be carried out under the auspices of Florida's Electrical Power Plant Siting Act codified under Part II of Chapter 403, Florida Statutes. As part of the procedures specified under that licensing process, FPL is in the process of preparing its Site Certification Application (SCA) for filing with the Department later this year. Of course, this "one-stop" licensing procedure under the siting act eliminates the need to obtain separate environmental permits from both the Department and numerous other agencies. Ultimately, the site certification determination will be considered and acted upon by the Governor and Cabinet, consistent with the procedure specified under Chapter 403, Florida Statutes.

In the meantime, at this stage of design and SCA preparation, FPL would prefer to avoid the need to obtain a U.S. Environmental Protection Agency (EPA) hazardous waste-related permit and would rather not have to address hazardous waste permitting considerations as part of its licensing application (SCA) which will be filed with the Department. Towards that end, and as we related to Department staff during the above-referenced meeting in your offices, it is FPL's intent not to "dispose" of any hazardous waste on the premises which will be the site of new electric generating unit and coal gasification facility construction and operation. Rather, any hazardous wastes generated at this facility will be properly manifested off-site for treatment or disposal by a licensed hazardous waste treatment or disposal facility, either in this state or elsewhere.

Likewise, no "storage" of hazardous waste will occur beyond the threshold time limits specified under applicable state and federal regulations. Any temporary accumulation of hazardous waste generated at this facility short of the timeframes referenced will be undertaken in accordance with all applicable provisions of rules governing such hazardous waste accumulation. Lastly, no "treatment" of hazardous waste will take place at the new electric generating units to be constructed and operated at FPL's existing Martin Plant site <u>unless</u> any such treatment occurs in an "elementary neutralization unit," a "totally enclosed treatment facility," or a "wastewater treatment unit" as those terms are defined under Department rules. For these reasons, it is FPL's conclusion that, pursuant to 40 CFR Section 270.1(c)(2) and the corresponding DER rule adopted by reference under Chapter 17-730, F.A.C., no separate U.S. EPA hazardous waste permit would be required for the hazardous waste management activities referenced above which may be undertaken at the site of the FPL Martin Expansion Project. Under the same rationale, no additional hazardous waste licensing requirements would apply at the Department level as part of the site certification process to be carried out under the provisions of the power plant siting law referenced above.

The opportunity to meet and discuss this matter with your staff on such relatively short notice was most worthwhile and we thank you and your staff for a useful meeting and dialogue on this topic. Should the Department differ with the findings and conclusions contained within this correspondence, I would ask you to notify me of that within the next two weeks because of the rigidity currently built into FPL's licensing timetable. Otherwise, FPL will proceed to complete the preparation and filing of the SCA for this project based upon the representations and conclusions contained in this letter.

Thank you in advance for your attention to this matter. Of course, should you have any questions or need additional clarification on any point raised in this correspondence, please let me know.

Sincerely,

HOPPING BOYD GREEN & SAMS

By: ______________________
William D. Preston

ATTORNEYS FOR FLORIDA POWER
AND LIGHT COMPANY

WDP/cla
cc: Diane Hunt
Robert Frost
Gary Early, Esq.

10.1.4 SECTION 10 OR 404 APPLICATIONS/PERMITS

FPL

P. O. Box 078768, West Palm Beach, FL 33407-0768
6001 Village Blvd.

December 14, 1989

Mr. Don Borda
Regulatory Division
U.S. Army Corps of Engineers
400 W. Bay Street
Jacksonville, Florida 32202-4412

FPL-JEN-COE-170-89-55

Re: FPL Martin CG/CC Plant -
Application for Construction, Dredging and
Filling in the Waters of the United States

Dear Mr. Borda:

Please find enclosed a completed DER Form 17-1.203(1), Joint Application for Activities in the Waters of the United States, prepared in accordance with COE and DER requirements.

The proposed facility will consist of four combined cycle generating units and four coal gasification plants designed to generate electricity from the combustion of coal gas. Location and basic layout of the facility are shown in Figures 1 and 2 of the attached Application.

As specified in the Federal Consistency Evaluation Procedures (15 CFR 930.50) all federal permits for which there are no analogous state permits require certification of compliance with approved Coastal Zone Management Programs. The permits issued pursuant to Sections 10 and 11 of the Rivers and Harbors Act of 1989, as amended, and Section 404 of the Federal Water Pollution Control Act of 1972, as amended, have no analogous State of Florida permits. Therefore, in accordance with the requirements of the Federal Consistency Evaluation Procedures, we are submitting, as an attachment to this Permit Application, a Coastal Management Program Consistency Certification. As specified in 15 CFR 930.58, a copy of the DER Form 17-1.203(1) and the Consistency Certification have been sent under separate cover to the Federal Consistency Coordinator of the Florida State Planning and Development Clearinghouse.

Mr. Mike Zimmerman of the COE Stuart office has performed a site inspection and verified that the wetland boundaries identified in the application are consistent with COE wetland jurisdiction.

10404.PERMIT-11/21/89

Should you have any questions concerning the above, please do not hesitate to contact us.

Sincerely,

June M. Small

JMS/kw

Enclosures

JOINT APPLICATION
DEPARTMENT OF THE ARMY/FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
For Activities in the Waters of the United States

CORPS APPLICATION NUMBER (official use only)	DER APPLICATION NUMBER (official use only)

1. APPLICANT'S NAME AND ADDRESS

JUNE M SMALL
NAME

P O BOX 078768/6001 VILLAGE BL
STREET

WEST PALM BEACH FL 33407
CITY STATE ZIP

TELEPHONE NUMBER (Day) (407) 640-2040 (Night) (407) 622-8911

2. Name, address, zip code and title of applicant's authorized agent for permit application coordination

Wayne Ondler
P.O. Box 078768
W. Palm Beach, Fl 33407

Telephone Number (407) 640-2042

3. NAME OF WATERWAY AT LOCATION OF THE ACTIVITY.

Isolated wetlands

DER Code ________
W/W Code ________

4. LOCATION WHERE PROPOSED ACTIVITY EXISTS OR WILL OCCUR.

Martin Power Plant Site, Western Martin County
Street, road or other descriptive location

19, 20, 21, 28, 29, 30 — Section
T39S — Township
37E — Range

N/A
Incorporated city or town

27 3' 13" — Latitude
80 33' 46" — Longitude

Martin
County

Tax Assessors Description: (if known)

28, 29, 37, 38 — Map No.
N/A — Subdiv. No.
N/A — Lot No.

5. NAME AND ADDRESS INCLUDING ZIP CODE OF ADJOINING PROPERTY OWNERS WHOSE PROPERTY ALSO ADJOINS THE WATERWAY.

All affected wetlands are within FPL owned property.

6. PROPOSED USE

Private Single Dwelling [ ] Private Multi-dwelling [ ] Public [ ]
Commercial [ ] Other [x] (Explain in remarks)
Public Electrical Utility

7. DESCRIPTION OF PROJECT (Use additional sheets, if necessary)

A. Structures: 1. New work [ ] Maintenance of existing structure [ ]

COE Work Code

2. Piers, docks and use: Commercial [ ] Private [ ] Public [ ]

a. Single pier [ ] length ______ width ______

b. Number of piers [ ] length ______ width ______

c. Number of boat slips [ ] length ______ width ______

d. Number of finger piers [ ] length ______ width ______

e. Other (please describe) ______

3. Seawalls, revetments, bulkheads: length ______

a. Type: Vertical [ ] Riprap [ ] Slope: ______ Horizontal: ______ Vertical

b. Material to be used ______

4. Other type of structure ______

B. Excavation or Dredging: New Work [ ] Maintenance work [ ] Total acreage involved ______

1. Access Channel [ ] or Canal [ ] Length ______ ft. Width ______ ft. Depth ______ ft.

2. Boat Basin [ ] or Boat Slip [ ] Length ______ ft. Width ______ ft. Depth ______ ft.

3. Other ______ Length ______ ft. Width ______ ft. Depth ______ ft.

4. Cubic yards: Total for project ______

a. ______ cyd. waterward/ ______ cyd. landward of ordinary/mean high water

b. Type of material to be excavated/dredged ______

C. Fill:

1. Amount of material

DER Code
253
403

a. Cubic yards placed waterward of ordinary/mean high water ______

b. Cubic yards placed landward of ordinary/mean high water ______

c. Total acreage to be filled ______ Total acreage of wetlands involved up to 205 acres

2. Containment for fill

a. Dikes [ ] b. Seawall, etc. [ ] c. Other (please explain) Grading and filling of uplands and depressions up to approx. 570 acres.

3. Type of fill material to be used ______

4. Source of fill material to be used ______

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8. Date activity is proposed to commence July, 1993 ; to be completed in 1996

9. Previous permits for this site have been DER # Corps #

A. Denied (date) NONE

B. Issued (date) NONE

C. Other (please explain) NONE

Differentiate between existing work and proposed work on the drawings.

10. Remarks (See Instruction Pamphlet for additional information required for all applications and certain activities. Use additional sheets if necessary.)

see attached text

11. AFFIDAVIT OF OWNERSHIP OR CONTROL of the property on which the proposed project is to be undertaken

I CERTIFY THAT: (please check appropriate space)

[x] I am the record owner, lessee, or record easement holder of the property described below.

[ ] I am not the record owner, lessee, or record easement holder of the property described below, but I will have before undertaking the proposed work the requisite property interest. (Please explain what the interest will be and how it will be acquired.)

LEGAL DESCRIPTION OF PROPERTY SITUATED IN Martin COUNTY, FLORIDA
(Use additional sheets if necessary)

(see attachment)

Signature

Sworn and subscribed before me at Palm Beach County, Florida, this 15th day of December, 1993

NOTARY PUBLIC

NOTARY PUBLIC STATE OF FLORIDA
MY COMMISSION EXP. JAN.14,1992
BONDED THRU GENERAL INS. UND.

My commission expires:

BEST AVAILABLE COPY

12. Application is made for a permit(s) to authorize the activities described herein.

A. I authorize the agent listed in Item #2 to negotiate modifications or revisions, when necessary, and accept or assent to any stipulations on my behalf.

B. I understand I may have to provide any additional information/data that may be necessary to provide reasonable assurance or evidence to show that the proposed project will comply with the applicable State Water Quality Standards or other environmental standards both before construction and after the project is completed.

C. In addition, I agree to provide entry to the project site for inspectors with proper identification or documents as required by law from the environmental agencies for the purpose of making preliminary analyses of the site. Further, I agree to provide entry to the project site for such inspectors to monitor permitted work if a permit is granted.

D. Further, I hereby acknowledge the obligation and responsibility for obtaining <u>all</u> of the required state, federal or local permits <u>before</u> commencement of construction activities I also understand that before commencement of this proposed project I must be granted separate permits or authorizations from the U.S. Corps of Engineers, the U.S. Coast Guard, the Department of Environmental Regulation, and the Department of Natural Resources, as necessary.

I CERTIFY that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities.

Signature of Applicant — Date: 12-15-89

<u>NOTE</u>: THIS APPLICATION MUST BE SIGNED by the person who desires to undertake the proposed activity or by an authorized agent. If an agent is applying on behalf of the applicant, attach proof of authority for the agent to sign and bind the applicant.

18 U.S.C. Section 1001 provides that: Whoever in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

NOTICE TO PERMIT APPLICANTS

This is a Joint Application; it is <u>NOT</u> a Joint Permit!

You Must Obtain <u>All</u> Required Local, State, and Federal

Authorizations or Permits <u>Before</u> Commencing Work!!

<u>For your information:</u> Section 370.034, Florida Statutes, requires that all dredge and fill equipment owned, used, leased, rented or operated in the state shall be registered with the Department of Natural Resources. Before selecting your contractor or equipment you may wish to determine if this requirement has been met. For further information, contact the Chief of the Bureau of Licenses and Motorboat Registration, Department of Natural Resources, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303. Telephone Number 904/488-1195. THIS IS NOT A REQUIREMENT FOR A PERMIT FROM THE DEPARTMENT OF ENVIRONMENTAL REGULATION.

183744

BEST AVAILABLE COPY

This instrument prepared by:
M. Craig Massey
P. O. Drawer J
Lakeland, Fla. 33802

WARRANTY DEED

THIS INDENTURE made this 6th day of December, A. D., 1972, by and between J. K. STUART and his wife, ALICE J. STUART, of the County of Polk, in the State of Florida, hereinafter referred to as the Parties of the First Part, and FLORIDA POWER & LIGHT COMPANY, a Florida corporation, of the County of in the State of Florida, hereinafter referred to as the Party of the Second Part, whose post office address is

P. O. Box 3100
Miami, Florida 33101

WITNESSETH:

THAT the said Parties of the First Part for and in consideration of the sum of Ten Dollars ($10.00) and other valuable consideration, to them in hand paid by the Party of the Second Part, the receipt whereof is hereby acknowledged, have granted, bargained, and sold to the Party of the Second Part, his heirs and assigns forever, the following described property lying and being in the County of Martin, State of Florida, to-wit:

The South 3/4 of Section 22, lying East of the right-of-way of Florida East Coast Railway Company;

All of Section 23, lying East of the right-of-way of Florida East Coast Railway Company;

All of Section 26 lying East of the right-of-way of Florida East Coast Railway Company;

Section 35 lying East of the right-of-way of the Florida East Coast Railway Company;

All of Section 24;

All of Section 25;

All of Section 36;

All the foregoing being in Township 39 South, Range 37 East;

The SW¼ of Section 29 less the East 50' thereof;

The S½ of the SE¼ of Section 29;

All of Section 30

All of Section 31;

The W½ of Section 32 less the East 50' thereof except through the South 100' of said tract;

The South 100' of the East ½ of Section 32 from the West boundary line of the said East ½ to a point on the South line of said Section coincident with a point on the North line of Section 5, Township 40 South, Range 38 East, that is 50' East of the West boundary line of the East ½ of said Section 5, subject to use of Martin County of the South 50' thereof as granted in conveyance recorded in Deed Book 39 at Page 433 of the Public Records of Martin County, Florida, all lying and being in Township 39 South, Range 38 East;

All the foregoing being in Township 39 South, Range 38 East.

Insofar as the described portion of the above in the East ½ of Section 32, as set forth above, the Parties of the First Part reserve as much of a right-of-way as is needed on said 100' strip in order to maintain road connections with Martin County Public Roads and easement reservations to the Parties of the First Part as to the West 100' of the South 100' and the West 50' of the East 100' of the West ½ of said Section 32, Township 39 South, Range 38 East on the perimeter of the described property only and solely for the connection between Martin County Public Roads and lands owned by the Parties of the First Part in Section 5 and Section 8 lying North of the St. Lucie Canal, both being in Township 40 South, Range 38 East.

The above also being less and except all easements, road rights-of-way, water, and canal rights-of-way of record, and fifty percent (50%) of the royalty from the total production of any oil, gas, or minerals extracted from the land unto J. K. Stuart, but without right of entry or to otherwise interfere with the surface rights of Party of the Second Part.

The royalty to J. K. Stuart to be reserved and excepted hereunder is in addition to and not included in the presently outstanding oil, gas, and mineral rights vested in third parties, that is to say, J. K. Stuart is reserving an undivided fifty per-cent (50%) royalty of the whole of the oil, gas, and minerals underlying said land.

Subject to taxes for the year 1973 and subsequent years. And the said Parties of the First Part do hereby fully warrant the title to said land, and will defend the same against the lawful claims of all persons whomsoever.

IN WITNESS WHEREOF, the said Parties of the First Part have hereunto set their hands and seals the day and year first above written.

Signed, Sealed and Delivered
in Our Presence:

B. J. Langston

M. Craig Massey

J. K. Stuart (L.S.)
J. K. STUART

Alice J. Stuart (L.S.)
ALICE J. STUART

STATE OF FLORIDA)
COUNTY OF POLK)

I HEREBY CERTIFY that on this day, before me, an officer duly authorized in the State and County aforesaid to take acknowledgments, personally appeared J. K. STUART and his wife, ALICE J. STUART, to me known to be the persons described in and who executed the foregoing instrument and they acknowledged before me that they executed the same.

WITNESS my hand and official seal at Bartow in the County and State last aforesaid this 6th day of December A. D., 1972.

Betty J. Walker
NOTARY PUBLIC
State of Florida at Large

My Commission Expires: 3-17-73

F-108

188362

WARRANTY DEED

JOSEPH D. FARISH, JR., joined by his wife, NELL B. FARISH, the grantors, in consideration of the sum of $10.00 and other good and valuable considerations received from FLORIDA POWER AND LIGHT COMPANY, the grantee, whose mailing address is Post Office Box 3100, Miami, Florida hereby on this 28th day of February, 1973, convey to the grantee the real property in Martin County, Florida, described as:

> South one-half (S½) of Section 19, Township 39 South, Range 38 East
> TOGETHER with all easements for ingress and egress as described in that certain deed dated 4 January 1972 and recorded in Official Records Book 334, page 703
> SUBJECT to any outstanding mineral interests of record not owned by the grantors

and covenant that the property is free of all encumbrances, that lawful seisin of and good right to convey that property are vested in the grantors, and that the grantors hereby fully warrant the title to said land and will defend the same against the lawful claims of all persons whomsoever.

Signed, sealed and delivered in the presence of:

Lorraine McDonald — Joseph D. Farish, Jr. (SEAL)
Joseph D. Farish, Jr.

[signature] — Nell B. Farish (SEAL)
Nell B. Farish

STATE OF FLORIDA)
COUNTY OF PALM BEACH)

I hereby certify that on this day, before me, a Notary Public duly authorized in the State and County named above to take acknowledgments, personally appeared before me Joseph D. Farish, Jr. and Nell B. Farish, his wife, to me known to be the persons described as grantors, in and who executed the foregoing instrument and they acknowledged before me that they executed the same.

Witness my hand and official seal in the State and County named above this 28th day of February, 1973.

Lorraine McDonald
Notary Public - State of Florida
My Commission expires: 4/12/75

(Notary seal)

This instrument was prepared by— W. R. SCOTT 700 Colorado Avenue Stuart, Florida

353 PAGE 334

SCOTT AND TILTON
ATTORNEYS AT LAW
700 COLORADO AVENUE
STUART, FLORIDA

1931 } **Best Available Copy**

This Indenture, made this 11th day of May, 1973, between CENTRAL BANK AND TRUST COMPANY, of Miami, Florida, a corporation duly organized under the laws of the State of Florida and duly authorized to accept and execute trusts within the State of Florida, not personally but as Trustee under the provisions of a deed or deeds in trust duly recorded and delivered to said Trust Company in pursuance of a certain Trust Agreement, dated the 10th day of May, 1968, and known as Trust Number 68-LT-24-569 party of the first part, and Florida Power & Light Company of Miami, Florida a corporation organized and operating under the laws of the State of Florida, party of the second part.

WITNESSETH, that said party of the first part, in consideration of the sum of Ten ($10.00) Dollars, and other good and valuable consideration in hand paid, does hereby grant, sell and convey unto said party of the second part, the following described real estate, situated in Martin County, Florida, to-wit:

See legal description attached hereto and made a part hereof.

together with the tenements and appurtenances thereunto belonging.

TO HAVE AND TO HOLD the same unto said party of the second part and to the proper use, benefit and behoof, forever, of said party of the second part.

Subject to:

All reservations, restrictions, easements and any oil, gas and mineral leases of record.

This deed is executed by the party of the first part, as Trustee, as aforesaid, pursuant to and in the exercise of the power and authority granted to and vested in it by the terms of said Deed or Deeds in Trust and the provisions of said Trust Agreement above mentioned, and of every other power and authority thereunto enabling, SUBJECT, HOWEVER, to the liens of all mortgages upon said real estate, if any, of record in said county; all unpaid general taxes and special assessments and other liens and claims of any kind, pending litigation, if any, affecting the said real estate; building lines; building, liquor and other restrictions of record, if any, party walls, party wall rights and party wall agreements, if any; Zoning and Building Laws and Ordinances; mechanic's lien claims, if any; easements of record, if any; and rights and claims of parties in possession.

IN WITNESS WHEREOF, said party of the first part has caused its corporate seal to be hereto affixed, and has caused its name to be signed to these presents by its Trust Officer and attested by its Vice-President, the day and year first above written.

CENTRAL BANK AND TRUST COMPANY,
as Trustee, as aforesaid and not personally

By: [signature]
Vice President ~~Trust Officer~~

Attest: [signature]
Assistant Vice-President

Signed, sealed and delivered in our presence.

Witnesses:

[signature] Ruth Sullivan

[signature] Patricia A. Bornocora

357 PAGE 487

This instrument was prepared by:
Patricia Bornocora
1313 NW 36th St.
Miami, Florida

TR710

LEGAL DESCRIPTION

The North 1/2 of Section 19, being 321 acres, more or less;
The West 1/2 and the North 400 feet of the East 1/2 lying West of State Road 710, less the Seaboard Coast Line Railroad right-of-way thereof of Section 20, being 338 acres, more or less;

The West 200 feet of the East 900 feet of the SE 1/4 lying South of State Road 710, less the Seaboard Coast Line Railroad right-of-Way thereof of Section 21, being 5 acres, more or less;

Section 28 less the East 700 feet thereof, being 560 acres, more or less;

The North 1/2, the East 50 feet of the SW 1/4, and the North 1/2 of the SE 1/4 of Section 29, being 406 acres, more or less;

The East 50 feet of the West 1/2 less the South 100 feet thereof, and the South 150 feet of the West 1420 feet of the East 1/2 less the South 100 feet of the West 1370 feet thereof, of Section 32, containing 4 acres, more or less;

All of the foregoing being in Township 39 South, Range 38 East, Martin County, Florida;

AND

The South 100 feet of that part of Section 4 lying on the Northerly side of the right-of-way of the St. Lucie Canal, containing 7 acres more or less;

The East 50 feet of the West 100 feet of the East 1/4 and the South 100 feet of the East 1/4, less the West 100 feet thereof, of Section 5, containing 9 acres, more or less;

Both of the foregoing being in Township 40 South, Range 38 East, Martin County, Florida. LESS, HOWEVER: An undivided three-fourths interest in the oil, gas and other minerals in, on and under the said lands.

Grantor hereby conveys all of its right, title and interest, if any, in and to all oil, gas and minerals, without Representation or Warranty.

FILED FOR RECORD
MARTIN COUNTY, FLA.
1973 MAY 18 PM 1:37
LOUISE V. ISAACS
CLERK OF CIRCUIT COURT
BY

193671 WARRANTY DEED

THIS INDENTURE, made this 24th day of May, 1973, between CARMEN MARGARITA ARRIETA MORAN, a single woman; ALBERTO ARRIETA NEGRON, individually, joined by his wife, ANNABELLE D. ARRIETA, also known as Annabel DiAntonis Arrieta; RAFAEL ARRIETA NEGRON, joined by his wife, ESTHER RIVERA ARRIETA; ROBERTO ARRIETA NEGRON, joined by his wife, ESTELLE BAN ARRIETA, parties of the first part, and FLORIDA POWER & LIGHT COMPANY, a Florida corporation, whose post office address is: P. O. Box 3100, Miami, Florida 33101

party of the second part,

WITNESSETH, That the said parties of the first part, for and in consideration of the sum of Ten ($10.00) Dollars and other good and valuable considerations, to them in hand paid by the said party of the second part, the receipt whereof is hereby acknowledged, have granted, bargained, and sold to the said party of the second part, its heirs and assigns forever, the following described land, situate, and being in the County of Martin, State of Florida, to-wit:

> All of Section 12 lying South of a line that is 3,257 feet South and parallel to the North line of Section 12, and the East 2,000 feet of Section 13, lying North of the St. Lucie Canal, in Township 40 South, Range 37 East, Martin County, Florida, together with, without representation or warranty, all of the right, title and interest, if any, of the Grantors to that portion of the St. Lucie Canal right-of-way which borders this property on the South.
>
> SUBJECT TO conditions, restrictions and limitations of record, if any, and taxes for the year 1973 and subsequent years. Reference to these restrictions and reservations shall not operate to reimpose the same.

245.21 Ac.

And the said parties of the first part do hereby fully warrant the title to said land, and will defend the same against the lawful claims of all persons whomsoever.

IN WITNESS WHEREOF, the said parties of the first part have

Return To
[illegible] Patterson [illegible]
1st National Bank Bldg
Miami, FLA. 33131

This Instrument Was Prepared By:
S. MACKAY BROWN
SHUTTS & BOWEN, Attorneys
1000 First National Bank Bldg.
Miami, Florida 33131

327397

BEST AVAILABLE COPY

This Indenture, made this 12th day of January 1979 between CENTRAL BANK AND TRUST COMPANY, of Miami, Florida, a corporation duly organized under the laws of the State of Florida and duly authorized to accept and execute trusts within the State of Florida, not personally but as Trustee under the provisions of a deed or deeds in trust duly recorded and delivered to said Trust Company in pursuance of a certain Trust Agreement, dated the 10th day of May, 1968, and known as Trust Number 68-19-24-569 party of the first part, and FLORIDA POWER & LIGHT COMPANY of Miami, Florida a corporation organized and operating under the laws of the State of Florida, party of the second part.

WITNESSETH, that said party of the first part, in consideration of the sum of ----------------------TEN AND NO/100 ($10.00) Dollars, and other good and valuable consideration in hand paid, does hereby grant, sell and convey unto said party of the second part, the following described real estate, situated in Martin County, Florida, to-wit:

1.

See legal description on Exhibit "A" attached hereto and by this reference expressly made a part hereof,

together with the tenements, hereditaments and appurtenances thereunto belonging or in any wise appertaining, including all of party of the first part's right, title and interest, if any, in and to all oil, gas and minerals in, on and under said real estate.

STATE OF FLORIDA DOCUMENTARY STAMP TAX DEPT. OF REVENUE JAN 15 '79 900.00

STATE OF FLORIDA DOCUMENTARY STAMP TAX DEPT. OF REVENUE JAN 15 '79 900.00

STATE OF FLORIDA DOCUMENTARY STAMP TAX DEPT. OF REVENUE JAN 15 '79 300.00

STATE OF FLORIDA DOCUMENTARY STAMP TAX DEPT. OF REVENUE JAN 15 '79 900.00

~~together with the tenements and appurtenances thereunto belonging~~

TO HAVE AND TO HOLD the same unto said party of the second part and to the proper use, benefit and behoof, forever, of said party of the second part.

This conveyance from party of the first part to party of the second part is made expressly subject to any and all conditions, restrictions, reservations (including outstanding oil, gas and mineral reservations), limitations, leases and easements of record, without intending to reimpose any or all of the same, to applicable zoning regulations and ordinances and to taxes for the current year and subsequent years.

This deed is executed by the party of the first part, as Trustee, as aforesaid, pursuant to and in the exercise of the power and authority granted to and vested in it by the terms of said Deed or Deeds in Trust and the provisions of said Trust Agreement above mentioned, and of every other power and authority thereunto enabling, SUBJECT, HOWEVER, to the liens of all mortgages upon said real estate, if any, of record in said county; all unpaid general taxes and special assessments [illegible] building lines; building, liquor and other restrictions of record, if any; party walls, party wall rights and party wall agreements, if any, Zoning and Building Laws and Ordinances, [illegible] easements of record, if any, and rights and claims of parties in possession.

IN WITNESS WHEREOF, said party of the first part has caused its corporate seal to be hereto affixed, and has caused its name to be signed to these presents by its Trust Officer and attested by its Vice-President, the day and year first above written.

CENTRAL BANK AND TRUST COMPANY,
as Trustee, as aforesaid and not personally

By: [signature]
Trust Officer

Signed, sealed and delivered in our presence.

Witnesses:

Charles Franklin Taaffe

Ruth Sullivan

Attest: [signature]
Vice-President

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11/70

EXHIBIT "A"

The E 1/2 of Section 20 lying South of Seaboard Coast Line Railroad Company right-of-way less and except the North 400 feet thereof, and

All of that portion of Section 21 lying South of the Seaboard Coast Line Railroad Company right-of-way, less and except the East 900 feet thereof.

Said lands situate, lying and being in Township 39 South, Range 39 East, Martin County, Florida.

ALSO

The West 30.7 acres of the E 1/2 of Section 13, less and except any portion of said 30.7 acres contained within Lot 24 and Lots 27 through 43 shown on the plat of Section Four, Sunset Grove, hereinbelow referenced, and

The West 282.64 feet of the NW 1/4, and all of the SW 1/4 of Section 13, and

All of Lots 628 through 649 and Lots 692 through 713 as shown on a plat of Section Three of Sunset Grove, a Division of Land in the E 1/2 of Section 13, by Wood and Associaties dated July, 1966, a copy of which is of record in the Public Records of Martin County, Florida, in O. R. Book 344, page 2022, and

All of Lots 23, 25, 26, 44, 51, 59, 64, 109, 110, 129, 130, 130A, 131, 132, 140 through 149, 194 through 204, 206 through 233, and 278 through 297, as shown on a plat of Section Four of Sunset Grove, a Division of Land in Section 13, by Wood and Associates, Inc., dated August, 1968, a copy of which is of record in the Public Records of Martin County, Florida, in O. R. Book 273, page 126.

All of Section 14, and

All of the SE 1/4 of the SE 1/4 of Section 15, and

All of the N 1/4 of Section 22, less and except therefrom the West 180 feet, and less the Florida East Coast Railway Company right-of-way, and less a strip of land lying westerly of and adjacent to the West line of said Florida East Coast Railway Company right-of-way; said strip of land being 255 feet in width in the NW 1/4 and 275 feet in width in the NE 1/4.

Said Sections 13, 14, 15 and 22 situate, lying and being in Township 39 South, Range 37 East, Martin County, Florida.

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045243 DEPT. OF REVENUE FLORIDA JAN 15 '79 P.B. 11058 DOCUMENTARY SUR TAX 200.00

045242 DEPT. OF REVENUE FLORIDA JAN 15 '79 P.B. 11058 DOCUMENTARY SUR TAX 900.00

79 JAN 15 A 9:15

ITEM 10 REMARKS

1.0 DEVELOPMENT SITE INFORMATION

1.1 NAME AND LOCATION OF PROPOSED DEVELOPMENT

FPL plans to construct a coal gasification/combined cycle (CG/CC) power plant on FPL's existing power plant site located in southwestern Martin County, Florida. The Martin Expansion Project will be located adjacent to the existing 1,600 MW power plant at the Martin Site.

Figure 1 illustrates the general location of FPL's Martin Site. The Martin Site is located five miles east of Lake Okeechobee and about seven miles west of Indiantown. The site is bounded on the west by the Florida East Coast (FEC) Railway and the adjacent South Florida Water Management District (SFWMD) Canal (Levee L-65); on the south by the St. Lucie Canal (Okeechobee Waterway); and on the north and east by State Rd. (SR) 710 and the adjacent CSX Railroad. The Martin Site is in the lower one-third of FPL's service area along Florida's eastern seaboard.

This remarks section provides information amplifying and supporting various application items including:

- o Development Site Information;
- o Project Alternatives; and
- o Wetlands.

The proposed Martin Expansion Project is designed for phased implementation of multiple combined cycle generating modules with coal gasification plant construction to follow combined cycle power plant development. The combined cycle power plants

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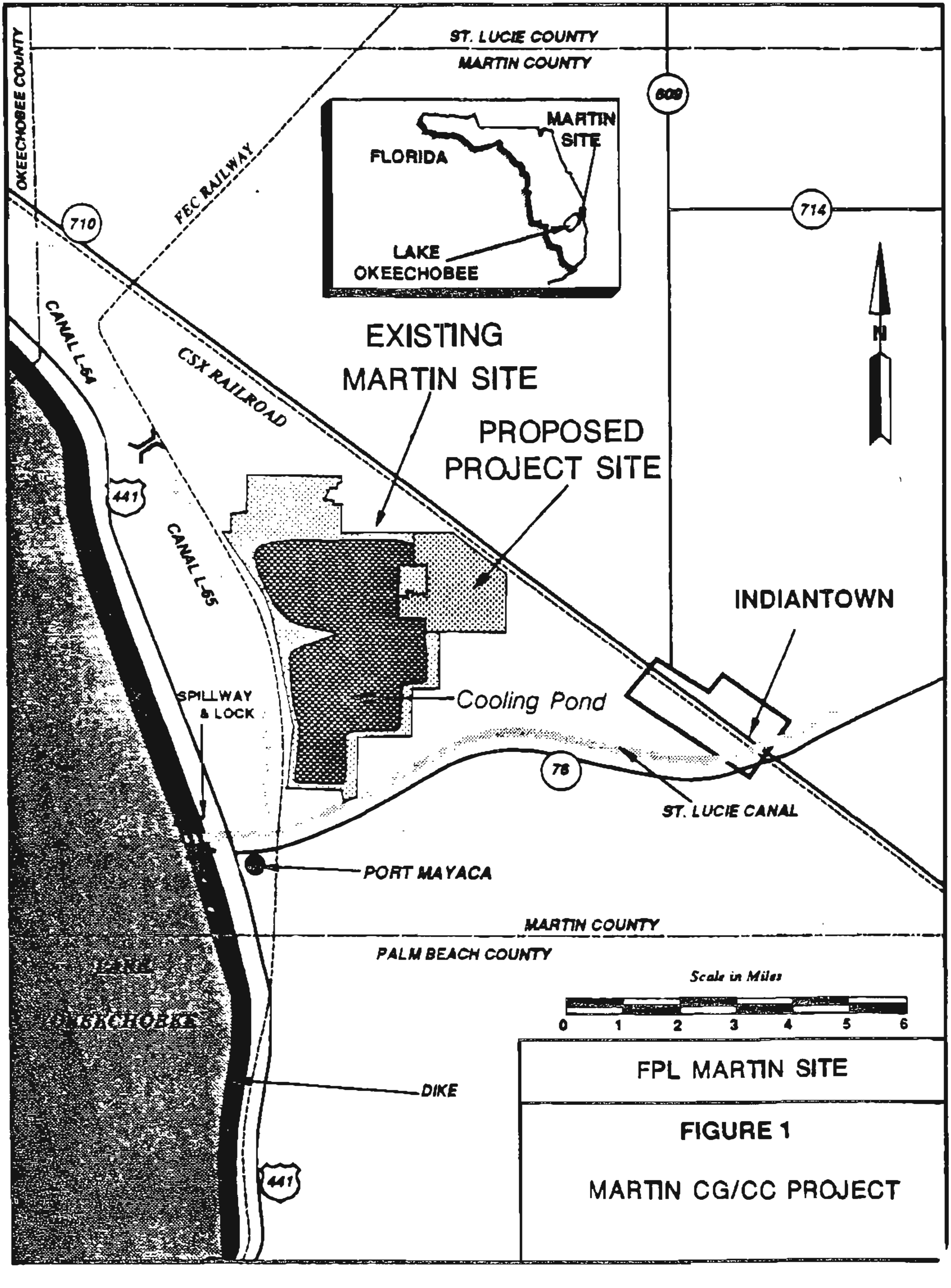


FPL MARTIN SITE

FIGURE 1

MARTIN CG/CC PROJECT

will consist of combustion turbines, heat recovery steam generators, steam turbines, and switchyards. The proposed expansion project will ultimately contain all the necessary facilities to convert coal into a low-sulfur, medium BTU fuel gas and to generate power from the cleaned fuel. Until the gasification plants are brought on line, natural gas will serve as the primary fuel for the CTs with No. 2 fuel oil as backup. A twelve mile section of the existing Indiantown - Martin 230KV transmission line will be upgraded as part of this project.

1.2 PROPOSED LAND USE/LAYOUT PLAN

The proposed Martin Expansion Project conceptual layout is included as Figure 2. The proposed land use breakdown is tabulated by functional description in Table 1. Those components of the power plant depicted on the conceptual plan are described below.

1.2.1 Location, Arrangement, and Dimensions

Power Block Area: The new power block area will be located adjacent to the existing power block area. Key combined cycle components generally include the combustion turbine/generators; coal gasification facilities; heat recovery steam generators; steam turbine/generators; and condensers. Other facilities in the power block area will include administration/service/ maintenance buildings; oil storage tanks and pumps; control buildings; water and wastewater treatment facilities; tanks; basins; stacks; switchyards and parking areas.

Key coal gasification components generally include coal grinding and drying modules; oxygen plant; gasifiers; gas treatment; sulfur recovery modules; and process and effluent water treatment.

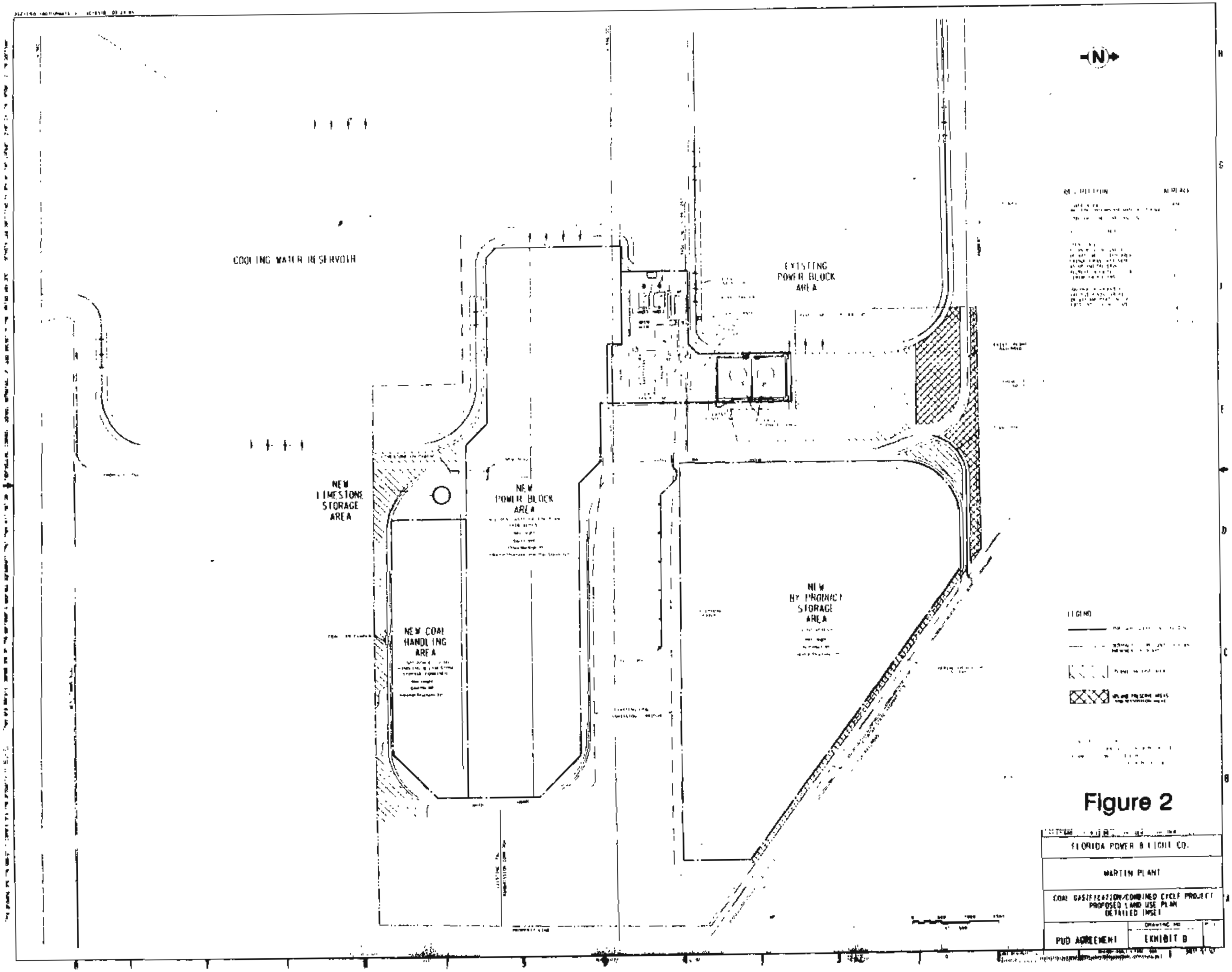

COOLING WATER RESERVOIR
EXISTING POWER BLOCK AREA
NEW LIMESTONE STORAGE AREA
NEW POWER BLOCK AREA
NEW COAL HANDLING AREA
NEW BY PRODUCT STORAGE AREA
LEGEND
FLORIDA POWER & LIGHT CO.
MARTIN PLANT
COAL GASIFICATION/COMBINED CYCLE PROJECT PROPOSED LAND USE PLAN DETAILED INSET
PUD AGREEMENT
EXHIBIT D

Figure 2

TABLE 1

FPL MARTIN CG/CC PROJECT

LAND USE BREAKDOWN

Land Use/ Functional Description	Size (Approximate Acreage)	Percent of Total Area
Power Block	210	10
Coal and Limestone Handling	420	19
By-Product Storage	550	26
Laydown & Material Storage	120	6
SUBTOTAL	1,300*	60
Balance of Property (Consisting of existing transmission line rights-of way, existing plant access roads, fringe areas, and portions of the existing cooling pond contiguous to the proposed project area)	890	40
TOTAL ACREAGE	2,190	100

* Does not include on-site Transmission Line right-of-way

Coal and Limestone Handling Areas: These areas will include coal and limestone unloading, storage, and reclaim equipment as well as runoff collection basins.

The coal, to be converted to gas, will be delivered by rail, discharged to the storage area and distributed to either the active (short-term storage) pile or the inactive (long-term storage) pile. Reclaim will be accomplished by means of a traveling bucket reclaimer or equivalent. The coal will be weighed, crushed and conveyed to the coal preparation system in the gasifier block.

Limestone will be delivered by rail also and discharged into a hopper. The limestone will be conveyed to a storage pile, where it will be reclaimed by means of an under-pile hopper and fed to the coal preparation system in the gasifier plant. Limestone inclusion will permit satisfactory gasification of a wide range of coals.

By-Product Storage: This area will be sized to store slag, an inert glassy material produced as a result of the gasification process, during the expected thirty year operating life of the plant. Slag will be distributed over the By-Product Storage Area in a manner which will maintain a stable storage state.

Laydown and Material Storage: This area will be used for storage of large pieces of equipment prior to initial installation and will also include temporary laydown of warehouse inventory prior to storage, etc.

Transmission Corridor/Access Road Areas: These areas will include rights-of-way access for existing power lines which will support the transmission of electricity off-site as well as access for site ingress/egress roadways. The transmission line rights-of-ways are expected to remain largely vegetated. The site access road system is largely established.

1.2.2 Parking and Loading Areas

The main parking area will be provided near the administrative offices and will serve employees primarily (1,000 by 1997). Other smaller parking areas will be located near operating stations. Major loading/unloading and storage areas have been designated on the conceptual layout; vehicle docking facilities will be provided to appropriate locations within the final site design.

1.2.3 Hazardous, Toxic and Deleterious Materials

The project is not expected to introduce any hazardous, toxic or deleterious materials into the aquatic environment.

1.2.4 Endangered/Threatened Species

The project is not expected to have any detrimental effect on populations of any endangered, threatened, rare or species of special concern.

2.0 PROJECT ALTERNATIVES (SITES AND GENERATION)

2.1 ALTERNATIVE SITES

The selection of the Martin site as the preferred location for the construction of the new CG/CC units is the result of site evaluation and selection efforts that began in the 1970's.

2.1.1 1979 Coal Plant Siting Study

By the mid-1970's, FPL's forecasts indicated that peak demand on its system would continue to rise as a result of population growth, despite reductions attributable to energy conservation and load management. The forecasted growth required additional generating capacity as early as 1985. FPL's experience with rising oil prices caused it to recognize a need for greater fuel diversity in its system. Because planning for such facilities must be initiated almost a decade before the earliest possible need date, FPL organized a "Coal Project" to carry out the necessary evaluations and studies in 1978.

One of the first tasks of the Coal Project was to conduct a siting study (the "1979 Siting Study"). The goal of that study was to identify the most favorable site in a twenty-five county region of South and Central Florida for construction of a coal plant consisting of two 700 MW class generating units. The five specific study objectives supporting that overall goal were:

- Identify broad, favorable siting areas in the region;
- Assemble a comprehensive list of potential sites;
- Select a small number of candidate sites;
- Evaluate and rate these sites; and
- Recommend the preferred site for a coal fired power plant.

The methodology used in the site selection study was designed to identify those sites that were most compatible with the environment and had the greatest potential for licensing. The methodology consisted of a three stage sequential screening process that began with the identification of 270 potential sites and progressed to a detailed environmental and economic evaluation of the ten best candidate sites.

There were three major stages in the site selection methodology for the 1979 siting study. In the regional screening stage, the entire twenty-five county study region was examined to identify large areas favorable for siting a coal fired power plant. Such areas have the highest probability of containing environmentally acceptable and licensable sites. A list of 270 potential sites located in the favorable areas were retained for further consideration.

The 106 potential sites that passed the regional screening were considered in the intermediate screening. This second stage involved a two phase screening process based upon both environmental and economic criteria. Using these criteria, ten of the 106 sites were identified as final candidate sites for detailed analysis.

In this third and final stage involving site specific analysis, the ten candidate sites were evaluated in detail, using a list of twenty-seven environmental siting criteria and three comprehensive, economic criteria. The ten sites were ranked according to numerical site suitability scores, calculated on the basis of site ratings for environmental criteria. A sensitivity analysis was also conducted to determine whether the ranking of the preferred site would change because of variations in the weights or ratings of the environmental criteria. Each site also underwent an indepth cost analysis based upon the economic criteria.

The study resulted in identification of the Martin Site, where two oil fired generating units were then under construction, as the preferred location for constructing a nominal 1,400 MW coal fired power plant. Both for environmental and cost factors, this site emerged with a significantly higher rating than the remaining nine candidate sites.

A cooling water pond had already been constructed at the site to serve all the units under construction. This pond was sized to provide cooling water for approximately 4,000 MW of generating capacity, whereas the oil units under construction were projected to generate about 1,700 MW. Thus, cooling capacity was available for the two 700 MW units anticipated for coal fired generation. The existing cooling system, ongoing site preparations and available transmission system connections were all factors substantially favoring this location in the evaluation of candidate sites. Ultimately, this coal unit was not constructed because the need was met through power purchased from the Southern Companies and construction of the St. Johns River Power Park, undertaken jointly with the Jacksonville Electric Authority.

2.1.2 Energy Capacity Study and South Florida Site Evaluation Study

In 1985, FPL initiated an ongoing yearly project, known as the Energy Capacity Study (ECS), to evaluate both the supply side and the demand side of FPL's overall system needs. Representatives from a number of FPL departments serve as members of the ECS group. The major goal of the annual study effort is to develop long range plans to meet the electric power needs of FPL's customers as reliably and economically as possible, giving due regard to environmental and other strategic considerations. The results of ECS are incorporated into the Ten Year Power Plant Site Plan and FPL's Annual Planning Hearing submissions to the PSC.

As a result of power supply planning analysis in the 1985 and 1986 ECS efforts, a need was identified for additional capacity within the Southeast Florida portion of the FPL system by the mid-1990's. To respond to this need, a South Florida Site

Evaluation Study was performed in 1987 to identify a group of preferred sites capable of accommodating several power supply options. Identification of sites was based on environmental resources in the area, as well as engineering and cost considerations. The study consisted of four individual tasks.

- o Task A: Combined Cycle Power Plant - Identification of preferred sites capable of accommodating two 380 MW combined cycle units.

- o Task B: Gasification Combined Cycle Power Plant and Gasification Plant - Identification of preferred sites capable of accommodating a 760 MW gasification combined cycle power plant, or a gasification plant capable of supplying synthetic gas to a 760 MW combined cycle plant.

- o Task C: Combined Cycle Repowering of the Lauderdale, Port Everglades and Turkey Point Plants.

- o Task D: Combined Cycle Power Plant, Gasification Combined Cycle Power Plant or Gasification Plant at the Martin Site.

Because the Martin Site was being evaluated for the entire range of technologies in a separate task, it was excluded from consideration as part of Tasks A and B.

A progressively complex evaluation methodology (similar to that utilized in the 1979 Siting Study) was used to identify and evaluate candidate sites. The three principal steps in that evaluation were:

- o Regional Screening Analysis - Identification of candidate areas from the study area by mapping environmentally sensitive areas.

- Intermediate Screening Analysis - Identification of candidate sites using environmental criteria and cost criteria.

- Site Specific Analysis - Evaluation of candidate sites using twenty-nine environmental criteria and developing site specific costs that included consideration of fuel supply, cooling system design, transmission and site development.

The results of each of the four study tasks are summarized below. In reviewing the results, it is important to note that the range of capital cost estimates for construction at each site were prepared on a consistent basis utilizing conceptual engineering characteristics. While these estimates can therefore be used to compare the relative economics of the various sites, they have not been updated since 1987 and cannot be meaningfully compared to the current cost estimates for the Lauderdale Repowering Project and the Martin Expansion Project. Those estimates have undergone continued refinement and updating as design and licensing efforts have progressed.

2.1.2.1 Results for Combined Cycle Power Plant Siting

In the Regional Screening Analysis, fourteen candidate areas were identified within Dade, Broward and Palm Beach Counties as potentially suitable for combined cycle power plant development. Of these fourteen areas, four were located in Dade County, three in Broward County and seven in Palm Beach County. Four areas were located in existing FPL power plant sites. These candidate areas ranged in size from about twenty-five acres, i.e., just sufficient space to locate a combined cycle plant, to about forty square miles. From these candidate areas, twenty-three candidate sites with at least two cooling system alternatives were identified in the Intermediate Screening Analysis. After performing an environmental screening of candidate sites, costs for sixty-three site and cooling system alternatives were developed. Ten candidate sites were then selected for further evaluation in the Site Specific Analysis. Each of the ten sites was found to be environmentally suitable if measures were taken to mitigate any potential environmental constraints. A list of the preferred sites is presented in Table 2. This table reflects a range of capital costs that account for potential mitigation that may be necessary at each candidate site.

2.1.2.2 Results for Gasification Combined Cycle Power Plant and Gasification Plant Siting

In the Regional Screening Analysis, eight candidate areas were identified within Dade and Palm Beach Counties as potentially suitable for a gasification combined cycle power plant or gasification plant development. Of these eight areas, three were located in Dade County and five were located in Palm Beach County. These candidate areas ranged in size from about six square miles to about forty square miles. From these candidate areas, eleven candidate sites with at least two cooling system alternatives were identified in the Intermediate Screening Analysis. After performing an environmental screening of candidate sites, costs for twenty-eight site and cooling system alternatives were developed. Six candidate sites were then selected for further evaluation in the Site Specific analysis. Five of these sites were found to be environmentally suitable if measures were taken to mitigate any potential environmental constraints associated with that site. Lists of the preferred

Table 2

Preferred Sites
Combined Cycle Power Plant

PREFERRED SITES	CAPITAL 1/ 3/ ($000)
FPL Owned Sites With Existing Facilities	
Lauderdale	$333,340-334,850
Port Everglades	$335,261-339,661
Turkey Point 2/	$362,710-365,826
FPL Owned Sites That Are Undeveloped	
Andytown South	$351,540-359,313
Mowry Canal 2/	$358,175-369,982
South Dade 2/	$337,825-380,081
Non-FPL Owned Sites	
Site A	$342,070-353,892
Site B	$351,351-362,539
Site C 2/	$353,978-365,785
Site D 2/	$361,892-372,164

1/ Total base plant capital cost is $299,178,000. The lower portion of the range includes the lowest cooling alternative, while the upper portion of this range includes only those costs to mitigate potential impacts associated with water supply and discharge options.

2/ Site requires the use of a premium (lower sulfur) fuel oil to meet PSD Class I increments when burned as a secondary fuel. Costs shown do not reflect this operational cost.

3/ Capital costs have been updated subsequently; however, the costs shown remain useful for purposes of comparison.

sites for a gasification combined cycle plant and gasification plant are presented in Tables 3 and 4, respectively. These tables reflect a range of capital costs that account for potential mitigation that might be necessary at each candidate site.

2.1.2.3 Results for Combined Cycle Repowering Siting

The evaluation for combined cycle repowering focused on FPL's existing steam generating units at the Lauderdale, Port based on an assessment of the strategic factors of location, Everglades and Turkey Point sites. These sites were selected unit size, site infrastructure and site layout.

Each of the three sites was found to be environmentally suitable for a repowering project. The costs associated with the three potential sites do not differ significantly. Given comparable costs on a $/KW basis, Lauderdale was selected as the preferred site, as it was best suited to meet the strategic considerations listed above.

2.1.2.4 Results for Martin Siting

The Martin Site was found to be environmentally suitable for a combined cycle plant, a gasification combined cycle plant or a stand alone coal gasifier. No significant potential environmental constraints were identified. Table 5 presents the capital costs for a combined cycle power plant, gasification combined cycle power plant or gasification plant at the Martin Site on a basis consistent with the other portions of the 1987 study.

Table 3

Preferred Sites
Stand-Alone Gasification Plant

PREFERRED SITES	CAPITAL 1/ 2/ ($100)
FPL Owned Sites With Existing Facilities	
Turkey Point	$681,273-687,036
Mowry Canal	$672,754-693,766
Non-FPL Owned Sites	
Site E	$609,295-627,469
Site D	$604,668-623,952
Site C	$627,319-648,331

1/ Total base plant capital cost is $542,209,000. The lower portion of the range includes the lowest cooling alternative, while the upper portion of this range includes only those costs to mitigate potential impacts associated with water supply and discharge options.

2/ Capital costs have been updated subsequently. However, the costs shown remain useful for purposes of comparison.

Table 4

Preferred Sites
Combined Cycle Gasification Power Plant

PREFERRED SITES	CAPITAL 1/ 3/ ($100)
FPL Owned Sites With Existing Facilities	
Turkey Point 2/	$1,022,584-1,028,347
Mowry Canal 2/	$1,011,665-1,034,677
Non-FPL Owned Sites	
Site E	$940,111-960,285
Site D 2/	$941,577-962,861
Site C 2/	$956,251-979,263

1/ Total base plant capital cost is $841,387,000. The lower portion of the range includes the lowest cooling alternative, while the upper portion of this range includes only those costs to mitigate potential impacts associated with water supply and discharge options.

2/ Site requires the use of lower sulfur fuel to meet PSD Class I increments when burned as a secondary fuel. Costs shown do not reflect this cost.

3/ Capital costs have been updated subsequently. However, the costs shown remain useful for purposes of comparison.

Table 5

Summary of Site Specific Analysis for the Martin Site

Plant	Capital 1/ 2/ ($000)
Combined Cycle	$333,013
Gasification Combined Cycle	$882,179
Gasification Plant	$555,747

1/ Total base plant capital costs are $299,178,000, $841,387,000 and $542,209,000 for a combined cycle and gasification plant, alone.

2/ Capital costs have been updated subsequently. However, the costs shown remain useful for purposes of comparison.

2.1.2.5 Conclusions

The South Florida Site Evaluation Study showed that a number of environmentally suitable sites exist for all of the technologies under construction. The final selection of the Martin Site as the preferred location for both the new combined cycle units and the new CG/CC plant was based on the following determinations:

- The existing Martin Plant Site has no significant environmental constraints. As a developed site with an existing cooling pond sized for additional capacity, the impacts associated with developing the Martin Site would be minimized.

- The Martin Site has significantly better economics than the other combined cycle or CG/CC sites evaluated, due in large part to the availability of existing cooling pond capacity.

- The site has sufficient land availability to support both the combined cycle units, a CG/CC plant and a potential future coal gasification facility for the combined cycle units.

- Minimal transmission system upgrades will be required to integrate the new generation into the electric grid; and

- The site is ideally situated for fuel delivery, having nearby gas pipeline capacity to support the combined cycle units and offering proximity to two competing rail delivery systems.

2.2 GENERATING ALTERNATIVES

In selecting CG/CC facilities for the Martin Site, an evaluation of various generating technologies was undertaken. First, a "short list" of capacity options was created by eliminating from a comprehensive list those alternatives which did not meet in-service availability, technological maturity or technical feasibility criteria. The initial list was created by reviewing the EPRI Technical Assessment Guide (TAG) which lists approximately seventy-five generating technologies and selecting from similar options those which would most likely be considered by FPL (e.g., coal units using lignite or oil fired units using distillate as a primary fuel source are unlikely to be considered by FPL). Technologies with similar characteristics (e.g., various types of CG/CC) are also combined and evaluated as one unit. Table 6 presents the total list of thirty-seven options considered in the evaluation. In deciding which options to retain for economic screening, three criteria were applied. First, the alternative must be capable of being sited, licensed and constructed to meet a commercial in-service date between January 1, 1992 and January 1, 1996. Second, the alternative must have been demonstrated on a suitable scale for utility use (100 MW) or have a major sponsor (EPRI, DOE, Utility or Industry) capable of supporting such a demonstration project. Third, the alternative must be suitable for use in the FPL service territory, i.e., sufficient resources must be available to develop the option. For example, FPL does not have sufficient water resources to construct a hydro unit within its service territory.

Based on the above criteria, a "short list" of generating options to be evaluated through economic screening was developed. This list included:

TABLE 6

SCREENING EVALUATION OF GENERATION TECHNOLOGIES

TECHNOLOGY	IN-SERVICE AVAILABILITY	TECHNOLOGICAL MATURITY	TECHNICAL FEASIBILITY	RETAIN FOR ECONOMIC SCREENING ?
Coal Technologies				
Coal, Steam, Wet Limestone FGD, Sub-critical, 400 MW	1994	Existing	Feasible for FPL	Y
Coal, Steam, Wet Limestone FGD, Sub-critical, 600 MW	1994	Existing	Feasible for FPL	Y
Coal, Steam, Dry FGD Subcritical	1994	Existing	Limited fuel range	N
Atmospheric Fluidized Bed, Circulating	1994	Demo Projects	Feasible for FPL	Y
Atmospheric Fluidized Bed, Bubbling	1994	Demo Projects	Feasible for FPL	N (Preferred for Retrofit)
Pressurized Fluidized Bed, Bubbling, Combined Cycle	1996	No demo to date	Feasible for FPL	N
Coal Gasification, Combined Cycle	1994	Demos of major Technologies	Feasible for FPL	Y
Oil/Gas Technologies				
Oil, Steam Wet Limestone FGD, 400 MW	1993	Existing	Feasible for FPL	Y
Conventional Combustion Turbine	1992	Existing	Feasible for FPL	Y
Advanced Combustion Turbine	1992	Testing complete 1st delivery made	Limited fuel range	Y
Intercooled injected Gas Turbines	1994	No demo to date	Feasible for FPL	N
Conventional Combined Cycle	1992	Existing	Feasible for FPL	Y

TABLE 6 (continued)

SCREENING EVALUATION OF GENERATION TECHNOLOGIES

TECHNOLOGY	IN-SERVICE AVAILABILITY	TECHNOLOGICAL MATURITY	TECHNICAL FEASIBILITY	RETAIN FOR ECONOMIC SCREENING ?
Oil/Gas Technologies (continued)				
Advanced Combined Cycle	1992	Testing of CT complete; 1st delivery made	Feasible for FPL	Y
Advanced CT Repowering	1992	Testing of CT complete; 1st delivery made	Feasible for FPL	Y
Fuel Cell Phosphoric Acid	1997	No demo to date	Feasible for FPL	N
Fuel Cell Molten Carbonate	1997	No demo to date	Feasible for FPL	N
Fuel Cell - Solid Oxide	1997	No demo to date	Feasible for FPL	N
Nuclear Technologies				
Pressurized Water Reactor	2000	Existing	Feasible for FPL	N
Liquid Metal Fast Breeder Reactor	Beyond 2005	No demo to date	Feasible for FPL	N
Advanced Passive Reactor	Beyond 2005	No demo to date	Feasible for FPL	N
Hydro Technology				
Conventional	1992	Existing	Insufficient resources for FPL	N
Renewable Technology				
Geothermal	1992	Existing	Insufficient resources for FPL	N
Wind Turbine	1992	Existing	Insufficient resources for FPL	N
Hybrid Solar Central Receiver	1997	Existing	Concern over production capabilities	N
Solar Photovoltaic	1997	Existing	Concern over production capabilities	N

TABLE 6 (continued)

SCREENING EVALUATION OF GENERATION TECHNOLOGIES

TECHNOLOGY	IN-SERVICE AVAILABILITY	TECHNOLOGICAL MATURITY	TECHNICAL FEASIBILITY	RETAIN FOR ECONOMIC SCREENING ?
Ocean Thermal	1997	No major sponsor	Feasible for FPL	N
Ocean Current	1997	No major sponsor	Feasible for FPL	N
Ocean Wave	1997	No major sponsor	Insufficient resource for FPL	N
Ocean Tidal	1997	Existing	Insufficient resource for FPL	N
Wood-Fired Steam	1992	Existing	Insufficient resource for FPL	N
Municipal Refuse Steam	1992	Existing	Pursued by others	N
Storage Technology				
Lead Acid Battery	1992	Existing, but may have supply limitations	Unknown	N
Advanced Battery	1992	Existing, but may have supply limitations	Unknown	N
Pumped Hydro Storage	1992	Existing	Inappropriate geology for FPL	N
Storage Technology 1/				
Compressed Air Energy Storage - Rock, Salt, Aquifer	1992	Existing	Inappropriate geology for FPL	N
Compressed Air Energy Storage Vessel	1992	Existing	Unknown	N
Superconducting Magnetic Energy Storage	1997-1999	No major sponsor	Unknown	N

1/ Detailed examination of storage technologies is to be done following the results of a feasibility study which will be conducted by FPL in 1989/90.

- Coal, steam, wet limestone FGD, subcritical, 400 MW
- Coal, steam, wet limestone FGD, subcritical, 600 MW
- Atmospheric fluidized bed circulating
- Coal gasification combined cycle
- Oil, steam, wet limestone FGD, 400 MW
- Conventional combustion turbine
- Advanced combustion turbine
- Conventional combined cycle
- Advanced combined cycle
- Advanced CT repowering

The second step in the screening evaluation was the development of screening curves that presented levelized capital and operating costs for each option on the "short list" over a range of capacity factors up to projected unit availability. These curves aided in further paring of the list alternatives to a manageable few.

This screening resulted in advanced combustion turbines, coal gasification/combined cycle, advanced combined cycle and 600 MW pulverized coal units, along with repowering, as warranting further detailed economic analysis. Based on relative economics and strategic considerations during that detailed economic analysis, combined cycle units and coal gasification/combined cycle units were determined to be the most appropriate generating technologies to meet the defined need for new capacity.

3.0 WETLANDS AND ACREAGE REQUIREMENTS

Wetlands will be lost due to this project because there is minimal opportunity for site layout arrangement to avoid on-site wetlands. Acreage requirements for the construction and operation of this project are presented in Table 7 along with

Table 7 Vegetation Communities Impacted by Construction of the Martin CG/CC Project (Approximate Acres)

Vegetation Community	Coal Handling Area[1)]	By-Product Storage Area	Power Plant	Existing On-Site Transmission Line	Total Potential Impact Area
Pine Flatwoods	260.8	179.2	37.8		477.8
Rangeland	1.7	3.1			4.8
Palmetto Prairie	149.5	151.8	13.8		315.1
Scrub/Brushland		18.1			18.1
Cabbage Palm/Oak		14.8			14.8
Pine/Cabbage Palm		44.2			44.2
Unimproved Pasture		54.1		267.1	321.2
Improved Pasture		39.1			39.1
Cypress	12.6				12.6
Cypress/Wet Prairie	1.8	7.0			8.8
Mixed Forest Wetland		5.1			5.1
Mixed Forest Wetland/ Wetland Scrub & Brushland		9.1			9.1
Wet Prairie	45.8	31.3	0.9	22.8	100.8
Rangeland/Mixed Aquatic Grasses	20.2				20.2
Sawgrass/Wet Prairie	27.1				27.1
Wetland Scrub/ Brushland			1.6		1.6
Disturbed Cleared Area			152.4		152.4
TOTAL ACRES	519.5	556.9	206.5	289.9	1,572.8

1) Includes area inside of the rail loop.

Source: Envirosphere Company, 1989.

vegetation community types affected. The power block area will occupy about 83 ha (206 ac) of land, most of which is currently cleared. These are areas previously cleared, grubbed and graded during construction of Martin Units 1 and 2. Coal handling and storage facilities will occupy about 210 ha (520 ac) of land, over one half of which is pine flatwoods and palmetto prairie. Approximately 44 ha (108 ac) of generally stressed wetlands occur in this area. The by-product storage area will cover about 225 ha (557 ac). Most of this land is covered by pine flatwoods and palmetto prairie. About 21 ha (52 ac) of grazed wetlands are included in this area. The existing transmission line and pipeline right-of-way on-site covers about 117 ha (290 ac). Most of this area is over-grazed, including wetlands.

A 30 m (100 ft) wide perimeter buffer between the by-product storage area and SR 710 and the CSX Railroad is to be preserved as a visual screening buffer zone and upland preservation area. Other upland preserve areas will be established between Plant Road and the cooling pond and at other locations along the southern portions of the CG/CC project site which are not to be developed. These areas will be allowed to succeed to forest habitat types where they are not already dominated by canopy sized trees.

None of the vegetation community types to be cleared for the project are uncommon or rare in Martin County. This observation is based on local helicopter flyovers and inspections of aerial photography and land cover maps of the area. Forest and Wetland types at the project generally appear more stressed from fire and grazing than similar community types off-site.

The area north of the existing oil tanks will be restored to an upland forest community.

3.1 SITE WETLANDS

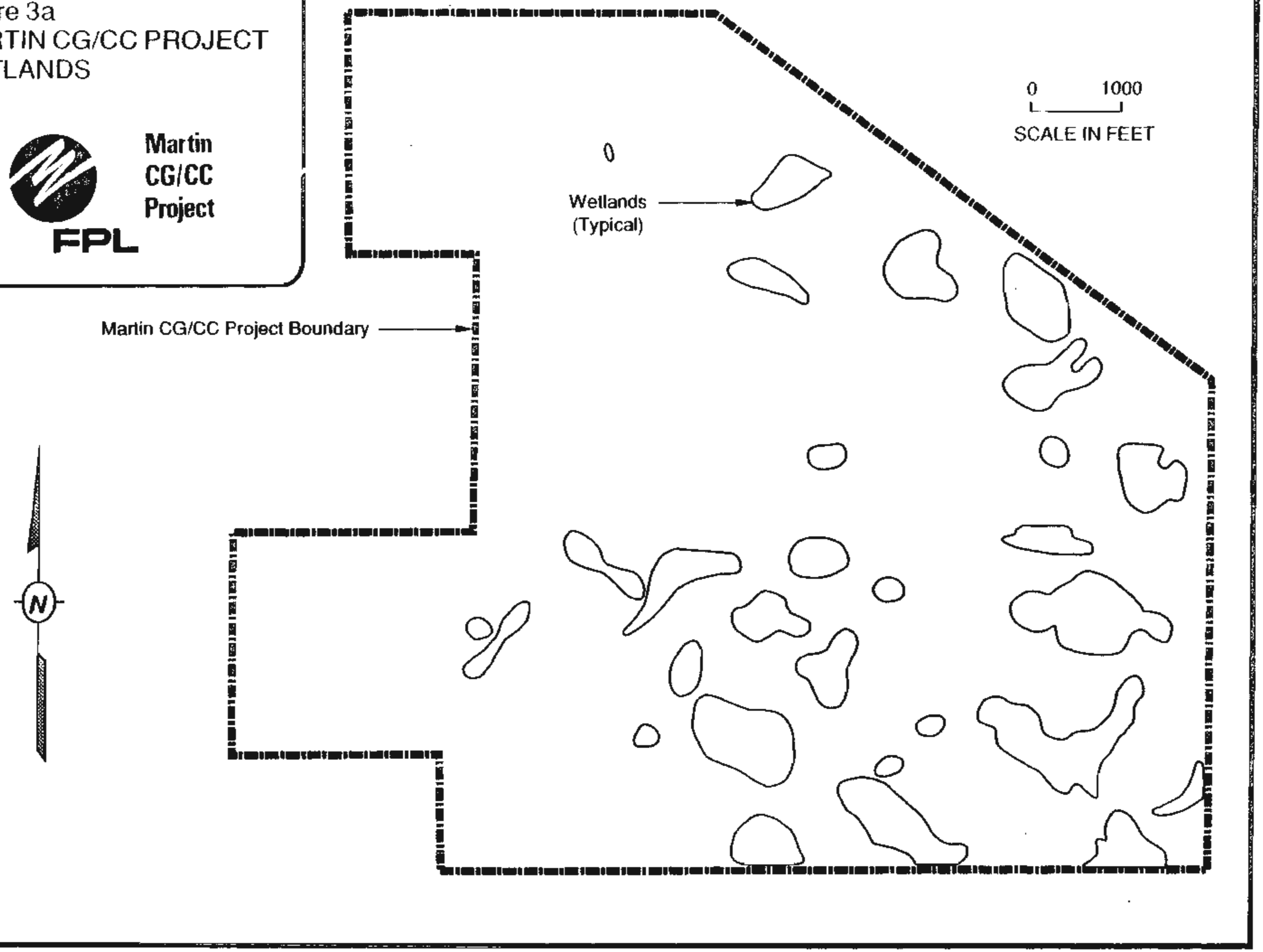
Wetlands, shown on Figures 3a and 3b, and described in Table 8, were delineated on the Martin County Assessment Map aerial photography dated April 1986 and color infrared aerial photography from August, 1988, each having a scale of 1:4800. Martin County Tax sheets numbered 28, 29, 37, and 38 were used.

Much of the area delineated in Figures 3a and 3b has been disturbed by fire and cattle grazing. Additionally, wetlands now occurring in the area east of the existing power block and within the transmission line right-of-way have been modified by previous transmission line construction. Functional values of wetlands shown in Table 8 are professional judgments based upon a given wetland's relative size, relationship to other natural systems, relative composition of hydrophytic vegetation, ecological successional maturity, saturated soil condition as observed on historical aerial photography, and relative habitat value of wetlands for wildlife. These functional values define the range of wetland functional attribute levels which are associated with a functional or viable wetland. Using this evaluation methodology, approximately 95 percent of the wetland areas identified within the project area are considered to be of low to medium functional value. Table 8 includes wetlands potentially affected by the project though the full total of 205 acres is not expected to be lost. For purposes of impact assessment, a conservative (excess) wetland loss is being evaluated.

3.2 MITIGATION PROGRAM

In October of 1988, an application was filed with Martin County

Figure 3a
MARTIN CG/CC PROJECT
WETLANDS



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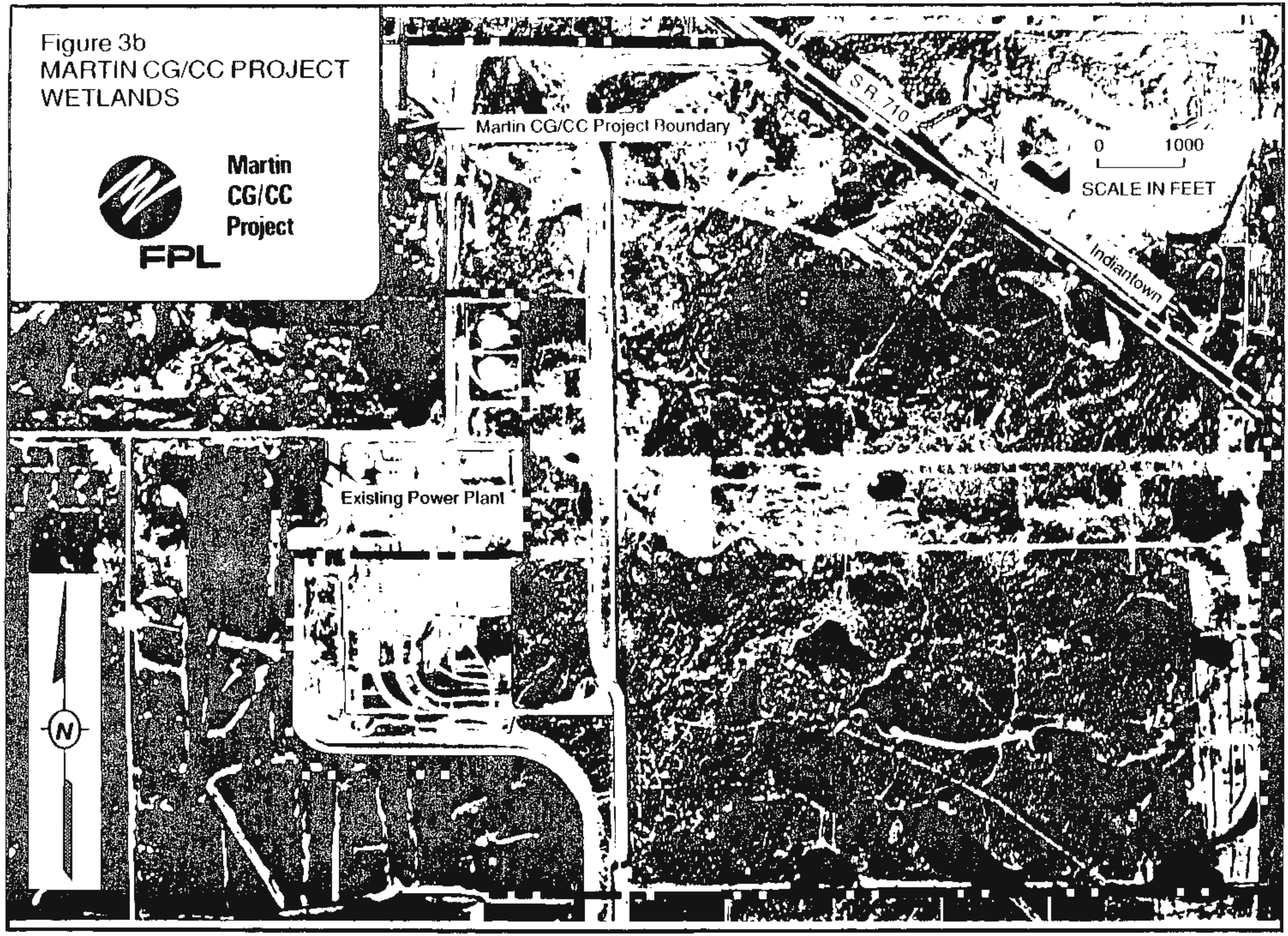

TABLE 8

FPL MARTIN CG/CC PROJECT
SUMMARY OF WETLANDS

WET-LAND SITE	APPROX SIZE	HYDROLOGICAL STATUS	ECOLOGICAL SUCCESSION MATURITY	LEVEL OF DISTURBANCE	REGIONAL SCARCITY	SPECIES DIVERSITY	FISHERIES & WILDLIFE VALUE	FUNCTIONAL VALUE	REMARKS
E1	0.5 Acres	Saturated Soils	Early	High; Fire; Grazing	Common	Low	Low	Low	
E2	5.6 Acres	Saturated Soils	Early	Moderate Grazing	Common	Low	Low		
E3	11.0 Acres	Locally Saturated Soils	Early	High; Fire Grazing; Farming	Common	Low	Low	Low to Medium	Farming in large transition area
E4	11.6 Acres	Locally Saturated Soils	Early to Medium (Small Section)	High; Fire; Grazing	Common	Medium	Medium	Low to Medium	Intense grazing at edge of wooded wetland area
E5	9.1 Acres	Locally Saturated Soils	Medium	Low to Moderate; Fire; Some grazing; Feral hogs	Relatively Common	High	Medium	Medium	Dense herbaceous and shrub layers
E6	4.0 Acres	Generally Unsaturated Soils	Early	High; Fire; Grazing	Common	Low	Low	Low	
E7	2.4 Acres	Unsaturated Soils	Early	High; Grazing	Common	Low	Low	Low	Essentially old field
E8	4.3 Acres	Locally Saturated Soils	Early	High; Fire; Grazing	Common	Low	Low	Low	
E9	1.8 Acres	Locally Saturated Soils	Early to Medium (Small section)	Low to Moderate; Some grazing	Common	Medium	Low	Low	Small open stand of bald cypress

TABLE 8

FPL MARTIN CG/CC PROJECT
SUMMARY OF WETLANDS (cont'd)

WET-LAND SITE	APPROX SIZE	HYDROLOGICAL STATUS	ECOLOGICAL SUCCESSION MATURITY	LEVEL OF DISTURBANCE	REGIONAL SCARCITY	SPECIES DIVERSITY	FISHERIES & WILDLIFE VALUE	FUNCTIONAL VALUE	REMARKS
E10	23.9 Acres	Saturated Soils	Early	Low	Relatively Common	High	Medium	Medium	Dense herbaceous stand; some open water
E11	6.5 Acres	Locally Saturated Soils	Early	High; Fire;	Common	Low	Low	Low	
E12	3.9 Acres	Locally Saturated Soils	Early	High; Fire; Some grazing	Common	Low	Low	Low	Trails and road present
E13	8.8 Acres	Saturated Soils	Early	High; Fire; Grazing; Road/ Ditch	Common	Low	Low	Low	
E14	18.3 Acres	Saturated Soils	Early	Low	Relatively Common	Medium	Medium	Medium	Sawgrass Marsh
E15	0.9 Acres	Generally Unsaturated Soils	Early	High; Grazing	Common	Low	Low	Low	
E16	0.8 Acres	Generally Unsaturated Soils	Early	High; Grazing	Common	Low	Low	Low	
E17	30.0 Acres	Saturated Soils	Early	Low	Medium (Size)	Medium	Medium	Medium	
E18	6.2 Acres	Saturated Soils	Early	Low	Common	Low	Low	Low	Adjacent to drainage ditch
E19	16.7 Acres	Saturated Soils	Early	Low	Relatively Common	Medium to High	Medium	Medium	

TABLE 8

FPL MARTIN CG/CC PROJECT
SUMMARY OF WETLANDS (cont'd)

WET-LAND SITE	APPROX SIZE	HYDROLOGICAL STATUS	ECOLOGICAL SUCCESSION MATURITY	LEVEL OF DISTURBANCE	REGIONAL SCARCITY	SPECIES DIVERSITY	FISHERIES & WILDLIFE VALUE	FUNCTIONAL VALUE	REMARKS
E20	7.3 Acres	Saturated Soils	Early	Moderate; Fire	Common	Low to Medium	Low to Medium	Low	
E21	1.4 Acres	Generally Unsaturated Soils	Early	High; Grazing	Common	Low	Low	Low	
E22	5.9 Acres	Locally Saturated Soils	Early	Moderate; Grazing; Road at Edge	Common	Low to Medium	Low	Low	
E23	7.0 Acres	Locally Saturated Soils	Mixture of Early and Mature	High; Grazing; Farming	Relatively Common	High	Medium	Medium	Small cypress dome and sawgrass marsh
E24	4.6 Acres	Generally Unsaturated Soils	Early Mature	High; Grazing	Common	Low	Low	Low	Essentially old field
E25	9.1 Acres	Saturated Soils	Early to Medium	Low	Common	Medium	Low	Low	Dense shrubs and herbaceous wetland
E26	5.9 Acres	Generally Unsaturated Soils	Early	High; Grazing; Fire	Common	Low	Low	Low	Essentially old field
E27	1.2 Acres	Unsaturated Soils	Early	High; Grazing;	Common	Low	Low	Low	Essentially old field
E28	10.2 Acres	Saturated Soils	Early	Low	Common	Low to Medium	Low	Low to Medium	In transmission line right-of-way

TABLE 8

FPL MARTIN CG/CC PROJECT
SUMMARY OF WETLANDS (cont'd)

WET-LAND SITE	APPROX SIZE	HYDROLOGICAL STATUS	ECOGOLICAL SUCCESSION MATURITY	LEVEL OF DISTURBANCE	REGIONAL SCARCITY	SPECIES DIVERSITY	FISHERIES & WILDLIFE VALUE	FUNCTIONAL VALUE	REMARKS
E29	4.1 Acres	Generally Unsaturated Soils	Early	High; Grazing	Common	Low	Low	Low	
E30	1.7 Acres	Saturated Soils	Early	Low	Common	Low to Medium	Low	Low	Seasonally hydrologically connected to E10; in transmission line right-of-way
E31	7.8 Acres	Saturated Soils	Early	Low	Common	Low to Medium	Low	Low	In transmission line right-of-way
ES1	0.7 Acres	Unsaturated Soils	Early	High; Fire; Grazing; Ditching	Common	Low	Low	Low	
ES3	17.8 Acres	Saturated Soils	Early to Mature	Moderate; Grazing	Relatively Uncommon	High	Medium	Medium to High	Cypress-dominated

NOTE: See Figure 3, Wetland Areas, for wetland site locations.

for rezoning of the project area from agricultural to industrial PUD. In August of 1989, the Martin County Board of County Commissioners formally approved these changes.

The PUD Agreement rezoning process concluded in establishment of the comprehensive wetland (and upland) mitigation program. Wetland restoration will take place on FPL-owned property adjacent to the north side of the cooling pond (Northwest Parcel). Figure 4 shows wetland restoration areas in the Northwest Parcel. This figure has been submitted to Martin County as part of the rezoning and Comprehensive Plan amendment process. The mitigation program also addresses the equivalency of amounts of wetlands and uplands lost with special emphasis on restoration of vegetation and wildlife habitat values. Table 9 presents a breakdown of vegetation community acreages associated with the three designated wetlands restoration zones (A - C) in the Northwest Parcel. The total impact to wetlands is the loss of about 205 acres, not including wetlands beneath the existing transmission line right-of-way on the site. The total mitigation area proposed for habitat preservation, restoration and enhancement is about 560 acres. This is a ratio of over 2 to 1 for wetland and buffer zone restoration and expansion with an additional area of about 100 acres for upland forest mitigation.

Areas A, B, and C are designated for wetlands restoration, enhancement, and preservation. Area C also includes valuable uplands including some unusual tropical hammock components which will be preserved while at the same time restoring adjacent cypress areas. The previous restoration of the 400-acre Barley Barber Swamp on the Martin Site illustrates both the likelihood of successful restoration and the FPL corporate commitment to fulfill mitigation programs undertaken.

Best Available Copy

Figure 4

NOTE:

Land Cover of Restoration Area A	
Pine Flatwoods and Associated Pine Communities	58 %
Other Habitats	17 %
Functional Wetlands	25 %
Totals	100 %

Land Cover of Upland Preserves Area D	
Pine Flatwoods	60 %
Cabbage Palm/Oak Hammock	15 %
Pine Cabbage Palm	8 %
Palmetto Prairie	17 %
	100 %

Land Cover of Upland Preserves Area E	
Mixed Flatwoods	29 %
Cabbage Palm/Oak Hammock	14 %
Pine/Cabbage Palm	[illegible]
Functional Wetlands	37 %
	100 %

MARTIN SITE

HABITAT PRESERVATION, ENHANCEMENT AND RESTORATION AREAS

AERIAL PHOTOGRAPH

OF THE NORTHWEST PARCEL

Table 9 Vegetation Communities in the Northwest Parcel Mitigation Area

Vegetation Community	Mitigation Area (Approximate acres)					
	Wetland Areas			Upland Areas		
	A	B	C	D	E	Total
Pine Flatwoods	138.3		74.0	35.0		247.3
Wet Prairie	19.4		9.8			29.2
Palmetto Prairie	8.0		70.7	9.8	0.1	88.6
Cabbage Palm/Oak	24.2			10.8	11.6	46.6
Pine/Cabbage Palm	3.1			8.1		11.2
Wetland Mixed Forest		1.3			6.1	7.4
Cypress	29.8	15.1			3.7	48.6
Cypress/Wet Prairie				0.3		0.3
Pine Flatwoods/Mixed					1.4	1.4
Unimproved Pasture				1.3		1.3
Willow	2.5					2.5
Wetland Shrub	1.5					1.5
Oak	3.4					3.4
Pine	11.0					11.0
Upland Mixed Forest	36.4	13.6			8.9	58.9
Total Acreage	277.6	30.0	154.5	65.3	31.8	559.2

Source: Envirosphere Company, 1989

Wetland preservation, enhancement, and restoration will include the following:

- Limiting grazing pressure;
- Maintenance of wetlands buffer zones;
- Initial removal and maintenance removal of feral hog populations;
- Restoration of wetland hydroperiod to halt the current transition process from wetlands to uplands, and then to enhance development of hydric soils and establishment of wetlands vegetation; and
- Maintenance removal of Brazilian pepper and Melaleuca.

The Barley Barber Swamp is a showcase wetland area visited by 4,000 to 5,000 visitors annually. Mitigation areas in the Northwest Parcel will be developed and maintained more as wilderness areas once mitigation programs are fully implemented. Access will be allowed only in response to approved special requests to FPL to conduct ecological research and for restoration program monitoring. Martin County has approved this concept. Specific characteristics of the mitigation program are presented below.

Limiting Grazing Pressure

The Northwest Parcel is currently overgrazed. With use of cross-fencing, cattle grazing will be limited within portions of the Northwest Parcel. Limited grazing will be allowed in the northeastern portion of Restoration Area A and in Restoration Area C. The rationale for allowing limited grazing in that specific portion of Restoration Area A is that this location has been heavily used by water birds for feeding. Grazing has appeared to enhance this location for wildlife use. Grazing will still be reduced by at least 50 percent in this area because current levels have resulted in overgrazing of this wetland.

The westernmost portion of Restoration Area C is largely pine flatwoods and palmetto prairie. Three isolated wetlands occur in this area and much of the flatwoods area is flooded during the wet season. Each of these isolated wetlands has been overgrazed. The proposed mitigation plan will allow limited grazing in these wetland areas. Fencing will separate Restoration Area A from Restoration Area C.

Maintenance of Wetlands Buffer Zones

Restoration Areas A and B include the primary restoration and enhancement wetlands of the mitigation programs. Wetlands in each of these areas are in varying states of transition to upland vegetation community types. The adjacent uplands in Restoration Areas A and B will not be cleared or harvested except when necessary to remove exotic vegetation and to install water flow control structures. For enhanced wildlife use and maintenance of wetlands stability, it is considered essential to preserve a wetland buffer zone.

Removal of Feral Hog Populations

Wetlands (and uplands) in the Northwest Parcel are frequently disturbed by feral hog activity as they are in the CG/CC project area particularly in forested wetland areas. Initial removal of feral hogs will take place by hunting and trapping. Mitigation areas will be inspected twice a year to monitor and, if necessary, remove (by trapping) new feral hog individuals.

Restoration of Wetlands Hydroperiod

Restoration of a hydroperiod necessary to reverse the current wetlands to upland vegetation and soil trend is proposed. The general restoration and enhancement process will occur as follows:

- o Provide an initial water level elevated enough to "shock" terrestrial species in the target wetland areas;

- o Engineer a site area water drainage system which will provide a water condition which will result in improved hydric soils; and

- o Engineer a water level regime which will provide appropriate seasonal water level changes to establish wetlands vegetation characteristic of sloughs or isolated wetlands.

Prior to implementing the mitigation engineering program, topographic information of the drainages, sloughs, and isolated wetlands in Restoration Areas A, B, and C will be consulted. Elevation information on adjacent properties will also be obtained. These data will provide the detail necessary to plan drainage realignments, and control structure locations and heights.

Recent and historical aerial photography indicate that drainage through Restoration Area A has been toward Black Bottom Slough through the three northern "arms" of this area. Drainage through Restoration Area B has been from northeast to southwest through poorly defined drainages amid cypress stands.

Over the last several decades several large and small ditches have been constructed to render portions of the land more suitable for development and for agriculture. The focus of the hydrological engineering effort will be to reestablish former surface drainage patterns without negatively affecting adjacent and "up-stream" properties. Additionally, a water source will be required to eliminate upland vegetation which has invaded wetland areas.

Water sources which will be available for both tasks can be provided from cooling pond seepage waters and from existing drainage in the vicinity of the Northwest Parcel.

Restoration Area A has direct water input from three large ditches (two entering it from the north and one from the east). All three ditches input to the slough at a downstream location. Studies will be conducted to determine the feasibility of routing at least portions of the northern ditches' drainage through the western arm of Restoration Area A. Similarly, water sources from ditches north of the eastern arm of Restoration Area A will be evaluated. Preliminary examination of topographic maps of the area indicate that installation of an adjustable screw-type control structure at the mouth of Black Bottom Slough, set at 22.1 to 22.3 ft MSL, will provide the initial shock to terrestrial species. The goal will be to back water up to at least the 22.1 ft level. Elevating water to this level will back water upstream in the slough several thousand feet and will inundate much of the historical flood plain. At the same time, waters will not be elevated on neighboring properties. Control structures will also be installed in canals and ditches to minimize water disposal upstream and off-site.

Water levels will be adjusted at the control structures to prolong the hydroperiod and to simulate the historical periods of inundation and dry season conditions. This process is being successfully used at the FPL Barley Barber Swamp on the east side of the Cooling Pond.

Restoration Area B has one relatively large ditch east of its boundary and two ditches south of its location. Other smaller man-made drainages are in the vicinity. The general vicinity of Restoration Area B also has two north-south drainages near its boundary, both emptying into a westward draining ditch. Adjustable control structures will be placed immediately downstream of the confluence of these ditches. The preliminary level will be set at 26.2 ft MSL. This level should also preclude backing waters onto adjacent land.

Prior to implementation of drainage control in Restoration Area C, this Area and Restoration Area E will be inspected for the presence of tropical hammock components as are currently known in Area B. The elevations of special upland areas will be surveyed to assure hydroperiod management will not threaten them.

Currently Restoration Area C is separated from its local drainage ditches by a small elevated berm. Several small culverts connect this area to the westerly draining ditch. These openings will be permanently closed to assist in the retaining of water in Restoration Area C. A single adjustable culvert will be constructed connecting the drainage ditch and the wetlands restoration area. Additionally, a berm will be created in areas between the ditch along the south side of Restoration Area C and the parallel north drainage ditch which are currently below proposed control water level elevations.

Engineering studies will be used to confirm the design of a system of control structures and pumps (as needed) to subsidize existing water in these wetland areas. Important in this process is the rehabilitation of a deteriorating organic soil ("O") layer supportive of wetland vegetation.

Terrestrial vegetation in target wetlands may be left in place to decompose and contribute to this organic layer. The tropical hammock portion of Restoration Area B will be monitored to ensure that its presence and species composition will not be threatened. No planting or transplanting of wetlands vegetation is anticipated.

Removal of Exotic Vegetation

The proposed mitigation program includes removal of Brazilian pepper and Melaleuca from all restoration areas. These species will be removed by hand and with use of herbicides applied to individual plants. Any reintroduction of these species will be monitored and plants removed quarterly.

Upland preservation will take place in undeveloped portions of the Martin CG/CC site (Figure 2) and in Upland Preserve Areas D and E in the Northwest Parcel (Figure 4). In addition, within the Project Site, selected upland preserve areas will be augmented with plant materials (mainly cabbage palms and oaks) transplanted from site areas slated for development. Once ecological succession progresses, the only maintenance will include removal of exotic tree species. By removing feral hog populations and cattle grazing as described above, ecological succession should proceed normally in each of the upland preservation areas.

In summary, with the mitigation program in place, project impacts on regional vegetation communities will be positive. No critical vegetation resources will be lost because existing ecological systems on-site are heavily stressed by fire, grazing, and feral hog activity. Additionally, the community types themselves are common to the region.

3.3. MITIGATION AREA

Mitigation monitoring in wetland Restoration Areas A-C will focus on the following vegetation, soil, and hydrological parameters:

- o Vegetation - Changes in species diversity and composition
  - Tree growth rates
  - Changes in canopy characteristics

- o Soil - Organic layer development (Composition/thickness/color)

- o Hydrology - Water levels
  - Length of time of soil saturation

Table 10 summarizes the proposed wetlands monitoring program. Sampling locations will be permanently marked. Water level indicator markers will be surveyed for elevation accuracy. Vegetation and soil sampling quadrats will be located in conjunction with as many of these surveyed markers as practical.

Table 10. Mitigation Monitoring Program

Parameter	Method	Frequency	Equipment
Vegetation o Diversity o Composition o Canopy	Quadrat; % Cover;	Canopy and middlestory 40 stations (10m x 10m) annually; shrub layer, 40 stations 10m x 10m) annually	DBH tape; meter sticks
Tree Growth	Cores; diameters	20 trees biannually	Increment borers; DBH tapes
Soil o Organic Layer	Soil core Color	Annually 40 stations	Hand auger; tape measure; Munsell Color Chart
Hydrology o Water Levels o Soil Saturation	Level markers (surveyed); Hand sampling	Monthly (10 locations); Monthly	Level indicator stakes (permanent)

Source: Envirosphere Company, 1989.

FCMP CONSISTENCY CERTIFICATION

FPL

P. O. Box 078768, West Palm Beach, FL 33407-0768
6001 Village Blvd.

December 15, 1989

State Planning & Development Clearinghouse
Office of Planning and Budgets
Executive Office of the Governor
The Capital
Tallahassee, Florida 32301

FPL-JEN-OPB-170-89-56

Attention: Federal Consistency Coordinator

RE: FCMP Consistency Review - FPL Martin CG/CC Plant
APPLICATION FOR CONSTRUCTION, DREDGING, AND
FILLING IN THE WATERS OF THE UNITED STATES

Dear Sir:

In accordance with the Florida Coastal Management Program (FCMP) and the Federal Consistency Evaluation Procedures (15 CFR 930.50), all federal permits for which there are no analogous state permits require certification of compliance with the FCMP.

Federal permits applicable to the referenced proposed project for which no analogous state permit exists include those required under Sections 10 and 11 of the Rivers and Harbors Act of 1989, as amended, and under Section 404 of the Federal Water Pollution Control Act of 1972, as amended. Although this Application for Construction, Dredging and Filling in the Waters of the State of Florida is a joint Florida Department of Environmental Regulation/U.S. Army Corps of Engineers application, it is not being submitted to the Florida Department of Environmental Regulation (DER) because there are no wetlands involved which are under the jurisdiction of the State of Florida. The attached letter from DER to Mr. D. Greg Braun, of FPL, explains the basis for this determination. Therefore, according to provisions of FS 380.23(3), since the State of Florida has no analogous permit requirements for this dredge and fill project, there is a need to submit a FCMP consistency certification.

In accordance with requirements of the Federal Consistency Evaluation Procedures, this Application must be accompanied by a consistency certification which includes:

- A written and pictorial description of the project;
- An assessment of probable impacts relevant to applicable FCMP statutes; and
- A signed statement by the applicant regarding consistency of the project with FCMP statutes.

As specified in 15 CFR 930.58, the Certification Package and Application must be sent to the appropriate agency and to the Federal Consistency Coordinator of the Florida State Planning and Development Clearinghouse. Therefore, FPL is submitting the enclosed Application and consistency certification package for it's Martin CG/CC Plant as required. The original Application and Certification Package was sent to the U.S. Army Corps of Engineers for their review.

If you have any questions or require any additional information, please contact me at (407) 640-2040.

Sincerely,

June M. Small
Manager
Environmental Resources & Planning

JMS:kw

Attachments

FCMP CONSISTENCY CERTIFICATION
FPL MARTIN CG/CC PLANT

DESCRIPTION OF THE PROJECT

Florida Power & Light Company (FPL) proposes to construct a coal gasification/combined cycle (CG/CC) power plant adjacent to the existing 1600 MW Martin Plant near Indiantown, Florida.

The existing Martin Plant, shown on Figure 1 of the attached Application, occupies a portion of the approximately 11,300 acre Martin Site, which includes a 6,800 acre cooling pond and a 300 acre area containing the power block for Martin Units 1 and 2. These two units have been in operation since December 1980 and June 1981, respectively.

The proposed expansion project is designed for phased implementation of four nominal 400 MW combined cycle generating modules with coal gasification plant construction to follow combined cycle power plant development. The combined cycle power plants will consist of combustion turbines (CTs), heat recovery steam generators (HRSGs), steam turbines and switchyards. The expansion project will ultimately contain all the necessary facilities to convert coal into a low sulfur, medium Btu fuel gas and generate power from the cleaned fuel. Until the gasification plants are brought on line, natural gas will serve as the primary fuel for the CTs with No. 2 fuel oil as backup. The CG/CC project, including the coal gasification plants and other facilities, will require approximately 1,300 acres of the existing site. Figure 2 of the attached Application provides a conceptual layout for the proposed expansion project.

ASSESSMENT OF PROBABLE PROJECT IMPACTS

As part of the Federal Consistency Evaluation Procedures, the following assessment was made of the probable impacts of the project relative to the Florida Coastal Management Program (FCMP) statutes.

Flood Zones - The Martin CG/CC Plant will be within Zone B (100 to 500 year flood plain area) as defined by flood insurance rate maps. All CG/CC facility building floor elevations will be at or above the 100 year flood elevation of 31 ft. NGVD. In addition, all CG/CC facilities will be designed to comply with all applicable South Florida Water Management District (SFWMD) and Florida Department of Natural Resources (DNR) requirements regarding flood protection control. Installation and operation of the CG/CC facility is expected to have no adverse impact on the 100-year flood elevations or flood flows. Since the plant will be entirely above the limits of the 100 year flood, adjacent property owners will not be adversely affected.

Air and Water Impacts - These concerns will be addressed by obtaining the appropriate facility operation and discharge permits and using pollution control measures to abate impacts from facility construction and operations. Air quality construction and operation permits will be obtained through the Power Plant Siting Act process in accordance with requirements established in the Prevention of Significant Air Quality Deterioration (PSD) regulations and the regulation governing New Sources. The existing wastewater discharge permit (NPDES) will be modified according to the needs of the new facility.

Stormwater retention basins will be used to collect runoff waters from the site. The discharge from these basins will comply with all Florida Department of Environmental Regulation (DER) and SFWMD requirements for protection of surface and ground water resources.

Archeological and Historical Resources Impacts - The Florida Division of Archives, History and Records Management has stated that there are no known or potential historical or archeological resources at the site. Therefore, no significant cultural resources will be affected by the construction or operation of the project.

Water Resource Impacts - The SFWMD will review the project for water resources impacts. Consumptive use of water is anticipated, therefore permits for such use will be obtained from SFWMD. Monitoring wells will be installed to provide an early warning system to monitor possible groundwater contamination, and stormwater management practices will be employed to mitigate impacts to water resources from runoff.

Power Plant Siting Act (PPSA) - An application is being filed with the DER under the Power Plant Siting Act. This application will present information discussing the conditions resulting from construction, and the anticipated impacts from facility operation, in order to provide assurance that all applicable state, regional and local standards are met and that the project will be consistent with the FCMP.

CONSISTENCY DETERMINATION

The proposed project complies with Florida's approved coastal management program and will be conducted in a manner consistent with such program.

June M. Small

Best Available Copy

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

JUL 1 8 1989

SOUTHEAST FLORIDA DISTRICT
BRANCH OFFICE
2745 SOUTHEAST MORNINGSIDE BOULEVARD
PORT ST LUCIE FLORIDA 34952

JUL 11 1989

Mr. D. Greg Braun, Environ. Coordinator
Florida Power & Light Co.
P.O. Box 14000
Juno Beach, Florida 33408

WRM - Martin County
FPL's Martin Power Plant
Expansion Project
Exemption Number: 431671178

Dear Mr. Braun:

This is to acknowledge receipt of your request for an exemption to: plug an existing ditch at the point of connection to Waters of the State at location seven (7) of attached figures one (1) and figure two (2).

Under the provisions of Section 403.913(4), Florida Statutes (FS), ditches meeting the 35 square foot cross-sectional area and the three foot depth criteria can be filled or plugged without a permit from this Department, thereby severing our jurisdiction over any ditch or wetland area connected solely to Waters of the State by said ditch -- assuming that a connection is needed for the Department to claim jurisdiction.

At this time no permit is required for your project by this Department. Any modifications in your plans should be submitted for review, as changes may result in permits being required. This letter does not relieve you from the need to obtain any other permits (local, state or federal) which may be required.

If you have any questions, please contact the undersigned of this office. When referring to this project, please use the file number indicated.

Sincerely,

Tom Franklin

Tom Franklin
Supervisor
Wetlands Resource Management

TF:cft/6

cc: Army Corps of Engineers, Miami
Don Keirn, D.N.R.

Best Available Copy

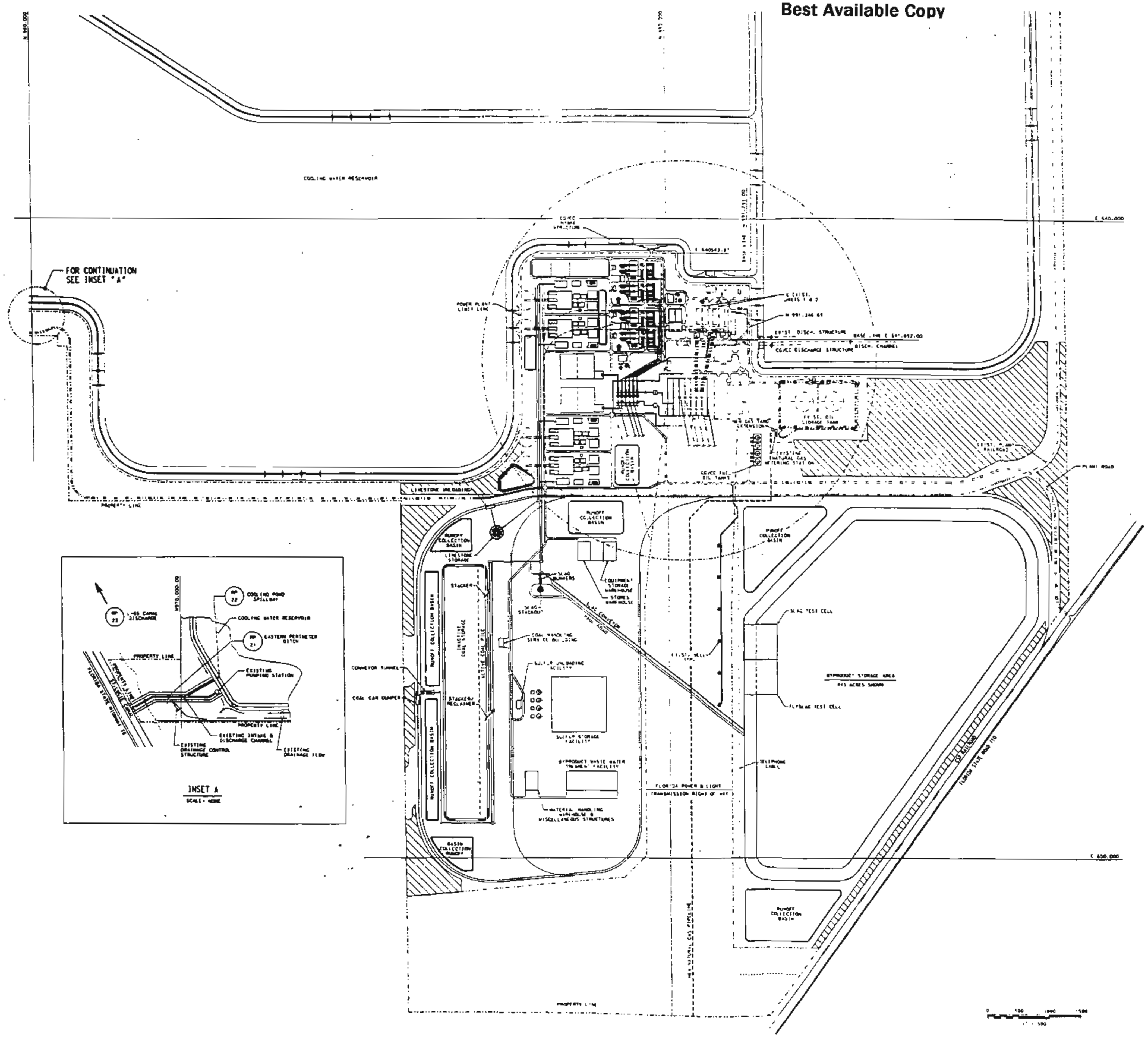

FIGURE 1

LAYOUT OF PROPOSED EXPANSION PROJECT

NOTES:

LEGEND:

Martin
CG/CC
Project

FPL

P O Box 078768, West Palm Beach, FL 33407-0768
6001 Village Blvd.

FPL

November 3, 1989

FPL-JEN-SPD-170-89-50

State Planning & Development Clearinghouse
Office of Planning and Budgets
Executive Office of the Governor
The Capital
Tallahassee, Florida 32301

Attention: Federal Consistency Coordinator

Re: FPL Martin CG/CC Plant
FAA-Coastal Zone Management Certification

Dear Sir:

In accordance with the Florida Coastal Management Program (FCMP) and the Federal Consistency Evaluation Procedures (15 CFR 930.50), all federal permits for which there are no analogous state permits require certification of compliance with the FCMP.

A federal permit applicable to the referenced proposed project for which no analogous state permit exists is the U.S. Department of Transportation, Federal Aviation Administration (FAA) Notice of Proposed Construction or Alteration (14 CFR 77). In accordance with requirements of the Federal Consistency Evaluation Procedures, this notice must be accompanied by a consistency certification which includes:

- A written and pictorial description of the project;
- An assessment of probable impacts relevant to applicable FCMP statutes; and
- A signed statement by the applicant regarding consistency of the project with FCMP statutes.

As specified in 15 CFR 930.58, the certification package and Notice of Proposed Construction (FAA 7460-1) must be sent to the appropriate federal agency (FAA) and to the Federal Consistency Coordinator of the Florida State Planning and Development Clearinghouse. Therefore, FPL is submitting the enclosed FAA Notice and consistency certification package for it's Martin CG/CC Plant as required. The original Notice and certification package was sent to the FAA Regional Office in Atlanta for their review.

If you have any questions or require any additional information, please contact me at 640-2042.

Sincerely,

Wayne Ondler

Wayne C. Ondler
Principal Specialist
Environmental Affairs

WCO/kw

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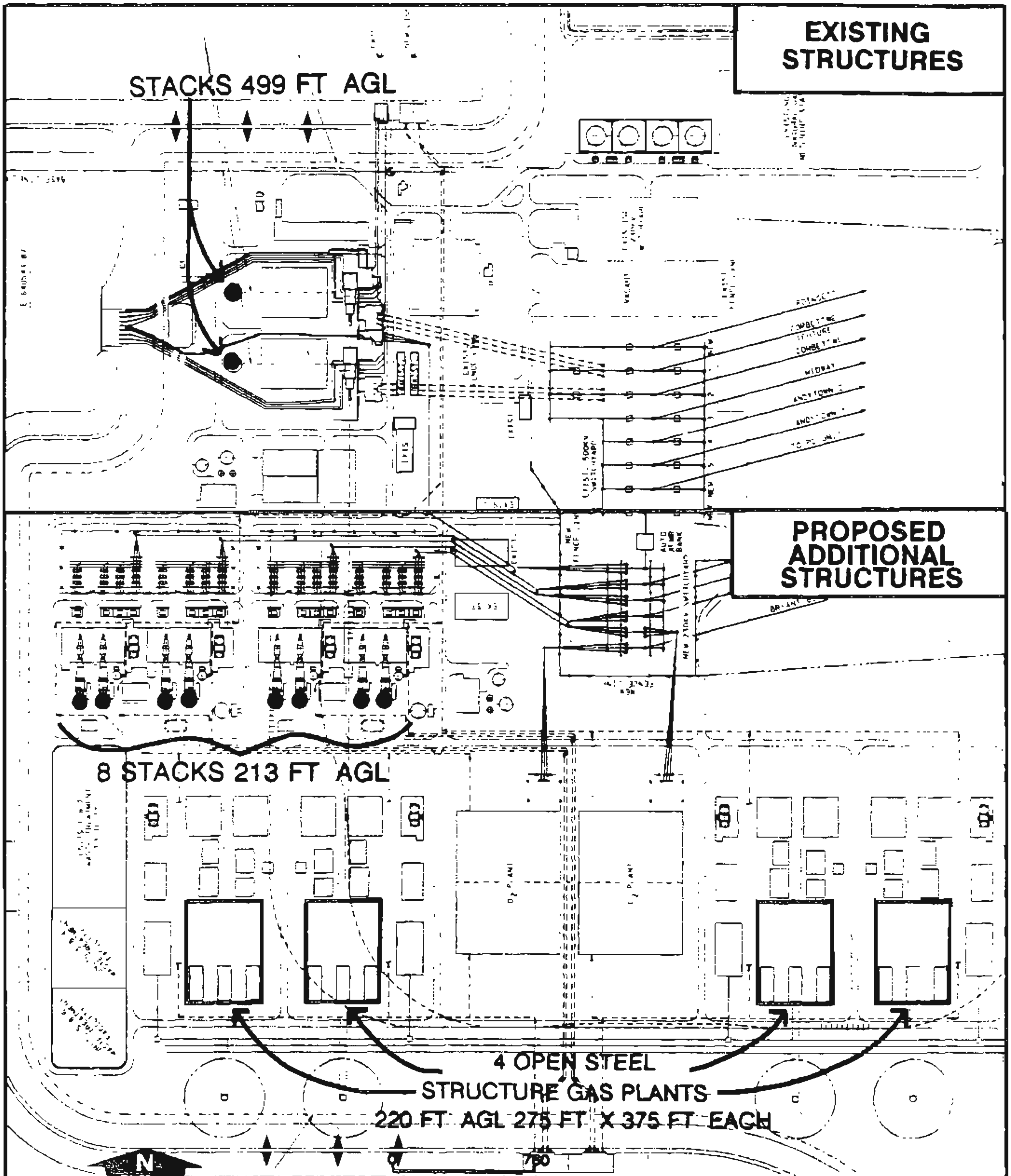

Figure: 1
MARTIN POWER PLANT STRUCTURES

Martin
CG/CC
Project

FPL

ATTACHMENT 1 OF 3 TO FAA FORM 7460-1

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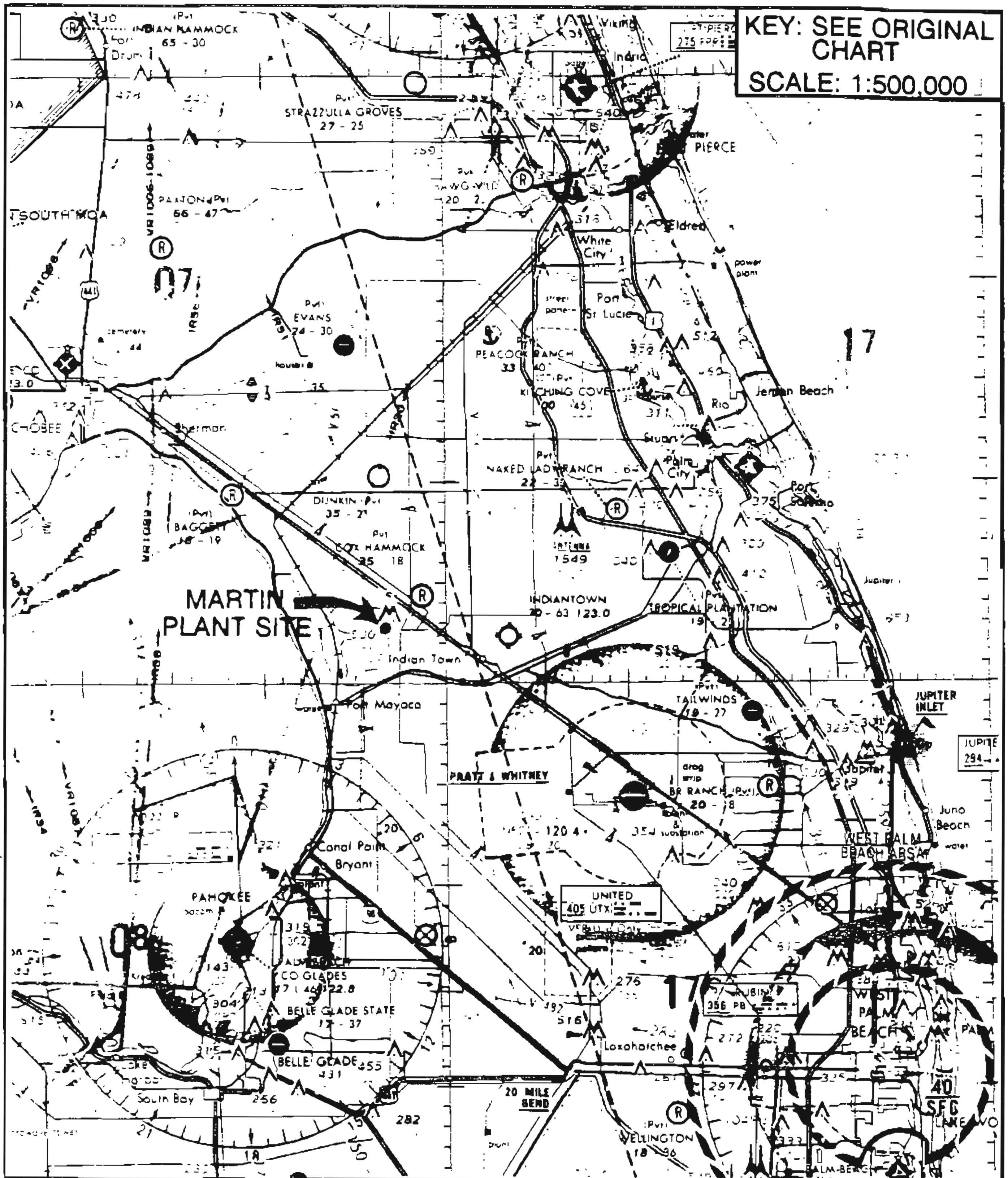

FIGURE 2

AERONAUTICAL CHART

SOURCE: MIAMI SECTIONAL AERONAUTICAL CHART, 44TH EDITION, MARCH 9, 1989

FPL

Martin CG/CC Project

TABLE 1

COORDINATES OF STRUCTURES EXCEEDING 200' IN HEIGHT
FPL MARTIN PLANT, INDIANTOWN, FLORIDA

Description	Latitude	Longitude	Height above ground (feet)	Height above mean sea level (feet)
Existing Nearby Structure:				
2 Power Plant Stacks	27 3'30"	80 33'58"	499	530
(Units 1 & 2)	27 3'33"	80 33'58"	499	530
Proposed Structures:				
8 Combustion Turbine	27 3'18"	80 34'04"	213	244
Stacks (steel)	27 3'18"	80 34'03"	213	244
	27 3'18"	80 34'01"	213	244
	27 3'18"	80 33'59"	213	244
	27 3'18"	80 33'56"	213	244
	27 3'18"	80 33'55"	213	244
	27 3'18"	80 33'52"	213	244
	27 3'18"	80 33'51"	213	244
4 Coal Gasification	27 3'9"	80 33'58"	220	251
Plant Buildings	27 3'9"	80 33'53"	220	251
(open steel structure)	27 3'9"	80 33'34"	220	251
	27 3'9"	80 33'28"	220	251

Best Available Copy

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Form Approved OMB No. 2120-0001

US Department of Transportation
Federal Aviation Administration

NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION

Aeronautical Study Number

1. Nature of Proposal

A. Type	B. Class	C. Work Schedule Dates
☒ New Construction	☒ Permanent	Beginning 1991
☐ Alteration	☐ Temporary (Duration ______ months)	End 1996

3A. Name and address of individual, company, corporation, etc. proposing the construction or alteration. (Number, Street, City, State and Zip Code)

(407) 640-2040
area code — Telephone Number

June M. Small
Florida Power & Light Company
P.O. Box 078768
West Palm Beach, Florida 33407

B. Name, address and telephone number of proponent's representative if different than 3 above

2. Complete Description of Structure

A. Include effective radiated power and assigned frequency of all existing, proposed or modified AM, FM, or TV broadcast stations utilizing this structure

B. Include size and configuration of power transmission lines and their supporting towers in the vicinity of FAA facilities and public airports

C. Include information showing site orientation, dimensions, and construction materials of the proposed structure

Units 3 through 6 of FPL's Martin Power Plant consisting of 8 combustion turbines and 4 coal gasification plants. See Table 1 and Figure 1 for additional details.

(If more space is required, continue on a separate sheet.)

4. Location of Structure

A. Coordinates (To nearest second)	B. Nearest City or Town, and State	C. Name of nearest airport, heliport, flightpark, or seaplane base
	Indiantown, Florida	Circle T Ranch Airport
Latitude: See Table 1	(1) Distance to 4B: 6.5 Miles	(1) Distance from structure to nearest point of nearest runway: 7.3 Miles
Longitude: See Table 1	(2) Direction to 4B: east - southeast	(2) Direction from structure to airport: East (96°)

5. Height and Elevation (Complete to the nearest foot)

A. Elevation of site above mean sea level	31'
B. Height of Structure including all appurtenances and lighting (if any) above ground, or water if so situated	See Table 1
C. Overall height above mean sea level (A + B)	See Table 1

D. Description of location of site with respect to highways, streets, airports, prominent terrain features, existing structures, etc. Attach a U.S. Geological Survey quadrangle map or equivalent showing the relationship of construction site to nearest airport(s). (If more space is required, continue on a separate sheet of paper and attach to this notice.)

6.5 miles WNW of Indiantown, Florida, 5.1 miles east of Lake Okeechobee, adjacent to south side of FPL Martin Power Plant on east side of Martin Plant cooling pond. See Figure 2 for location map.

Notice is required by Part 77 of the Federal Aviation Regulations (14 C.F.R. Part 77) pursuant to Section 1101 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1101). Persons who knowingly and willingly violate the Notice requirements of Part 77 are subject to a fine (criminal penalty) of not more than $500 for the first offense and not more than $2,000 for subsequent offenses, pursuant to Section 902(a) of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1472(a)).

I HEREBY CERTIFY that all of the above statements made by me are true, complete, and correct to the best of my knowledge. In addition, I agree to obstruction mark and/or light the structure in accordance with established marking & lighting standards if necessary.

Date	Typed Name/Title of Person Filing Notice	Signature
12/12/89	June M. Small	(signature)

FAA Form 7460-1 (8-85)

DO NOT REMOVE CARBONS

10.1.5 PSD APPLICATIONS/PERMITS

Following is a copy of the Prevention of Significant Deterioration (PSD) permit application for the Martin CG/CC project submitted to the FDER pursuant to requirements of the Federal Clean Air Act.

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

Table of Contents (Continued)

Table of Contents (Continued)

PSD PERMIT APPLICATION

FPL MARTIN CG/CC PROJECT

December 1989

1.0 INTRODUCTION

The Florida Power & Light Company (FPL) Martin Power Plant Site is located in the western portion of Martin County, Florida, approximately 161 km north of Miami, 64 km northwest of West Palm Beach, 13 km northwest of Indiantown, and 8 km east of Lake Okeechobee. Currently, the FPL Martin Plant consists of two 863 MW units which are permitted by Florida Administrative Code Rules 17-2 and 17-4 to burn low-sulfur (less than or equal to 0.7% sulfur by weight) No. 6 fuel oil or natural gas.

FPL is proposing a generation expansion project which will consist of the construction of four 400 MW coal gasification combined cycle (CG/CC) units. Each combined cycle unit will consist of two combustion turbines (CTs) and heat recovery steam generators (HRSGs). The CG/CC units will be primarily fired with natural gas with No. 2 distillate fuel oil as a backup during periods of natural gas supply interruption. Coal gasification facilities will be added later on, to serve as the source of fuel for the combined cycle units. Each CT/HRSG train will be served by a dedicated stack which meets good engineering practice (GEP) stack height specifications.

The Martin CG/CC Project will result in net increases in air pollutant emissions over the current emissions levels for the Martin Plant. The U.S. Environmental Protection Agency (U.S. EPA) has promulgated Prevention of Significant Deterioration (PSD) regulations (U.S. EPA, 1980a) which require a permit review and approval for new or modified existing sources which increase air pollutant emissions above specified threshold levels. Because the emission threshold levels will be exceeded by the proposed source, the CG/CC Project is subject to PSD review. The PSD regulations are promulgated under 40 CFR Part 52.21 and implemented, through EPA delegation of authority, by the Florida Department of Environmental Regulation (FDER). FDER's PSD regulations are codified in the Florida Administrative Code (FAC) Chapter 17-2.510. The completed FDER application forms for this proposed facility are attached.

The technical information and analysis required by the federal and state PSD regulations are contained in this PSD permit application. Although this document is an appendix to the Site Certification Application (SCA) for the proposed facility, it has been prepared as a stand-alone PSD permit application. The permit application is divided into eight major sections. Presented in Section 2.0 is a description of the facility, including air pollutant emissions and stack parameters. Air quality review requirements and applicability are presented in Section 3.0. The best available control technology (BACT) evaluation, is presented in Section 4.0. Ambient air quality monitoring data analysis is presented in Section 5.0, and the air quality modeling methodology and results of the air quality impact assessment performed for the proposed project are presented in Sections 6.0, 7.0, and 8.0.

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Power Generation Facility [X] New[1] [ ] Existing[1]

APPLICATION TYPE: [ ] Construction [ ] Operation [ ] Modification

COMPANY NAME: Florida Power & Light Company COUNTY: Martin

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) See Table 1.

SOURCE LOCATION: Street ______ City Indiantown

UTM: East 542.87 North 2992.43

Latitude ____° ____' ____"N Longitude ____° ____' ____"W

APPLICANT NAME AND TITLE: Florida Power & Light Company

APPLICANT ADDRESS: 710 Universe Blvd. Juno Beach, Florida 33408

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Coal Gasification/ Combined Cycle facility

I certify that the statements made in this application for a ______ permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: ______

______
Name and Title (Please Type)

Date: ______ Telephone No. ______

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

[1] See Florida Administrative Code Rule 17-2.100(57) and (104)

TABLE 1.

MARTIN CG/CC EMISSION SOURCES

Unit No. 3a CT/HRSG
Unit No. 3b CT/HRSG
Unit No. 4a CT/HRSG
Unit No. 4b CT/HRSG
Unit No. 5a CT/HRSG
Unit No. 5b CT/HRSG
Unit No. 6a CT/HRSG
Unit No. 6b CT/HRSG

Unit 3 Coal Gasification Plant Tail Gas Incinerator
Unit 4 Coal Gasification Plant Tail Gas Incinerator
Unit 5 Coal Gasification Plant Tail Gas Incinerator
Unit 6 Coal Gasification Plant Tail Gas Incinerator

Auxiliary Boiler for Units 3 and 4
Auxiliary Boiler for Units 5 and 6

Emergency Diesel Generator for Units 3 and 4
Emergency DIesel Generator for Units 5 and 6

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed ____________________

____
Name (Please Type)

Florida Power & Light Comapny
Company Name (Please Type)

710 Universe Blvd. Juno Beach, Florida 33408
Mailing Address (Please Type)

Florida Registration No. __________ Date: __________ Telephone No. __________

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

See attached sheet

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction June 1991 Completion of Construction December 1996

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

Not Applicable

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

No previous permits have been issued.

SECTION II. GENERAL PROJECT INFORMATION

Attachment A.

FPL plans to add multiple combined-cycle (CC) electrical generating units with supporting coal gasification (CG) units to its existing 11,300 acre Martin site. These new units are capable of firing natural gas, No. 2 fuel oil and coal-derived gas and are defined as Martin CG/CC Units 3, 4, 5, and 6. The CG/CC project also includes material handling and storage facilities for incoming fuel oil, coal, limestone and for the solid by-products of coal gasification - slag, fly slag, and sulfur. Note that Martin Units 1 and 2 are the site's existing oil/gas-fired units. The addition of the CG/CC units will increase the site's generating capacity from the existing 1600 MW (nominal) to approximately 3200 MW.

The CC portion of the facility will include steam injection for control of NO_x, fire low sulfur, low particulate fuels; provide good, efficient combustion to minimize CO, VOC, lead and other regulated and nonregulated pollutant emissions.

The CG units will contain all the equipment necessary to convert coal into a low sulfur, medium BTU fuel gas for use in the CC units. Specifically, the CG units will use dry collection and wet suppression systems for control of particulates from coal /limestone handling, wet particulate scrubbers for treatment of fuel gas particulates and an absorption/stripping system for removal of sulfur compounds in the fuel gas produced.

The CG/CC facility will be in full compliance with all applicable federal, state and local air quality regulations.

E. Requested permitted equipment operating time: hrs/day 24 ; days/wk 7 ; wks/yr 52 ;

if power plant, hrs/yr 8760; if seasonal, describe: ______

F. If this is a new source or major modification, answer the following questions. (Yes or No)

1. Is this source in a non-attainment area for a particular pollutant? No

   a. If yes, has "offset" been applied? Not applicable

   b. If yes, has "Lowest Achievable Emission Rate" been applied? Not applicable

   c. If yes, list non-attainment pollutants. Not applicable

2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. Yes

3. Does the State "Prevention of Significant Deterioriation" (PSD) requirement apply to this source? If yes, see Sections VI and VII. Yes

4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? Yes

5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? No

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? No

   a. If yes, for what pollutants? Not applicable

   b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted. Not applicable

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

Refer to PSD permit application documentation.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable: Not applicable.

Description	Contaminants Type	Contaminants % Wt	Utilization Rate - lbs/hr	Relate to Flow Diagram

B. Process Rate, if applicable: (See Section V, Item 1) Not applicable

1. Total Process Input Rate (lbs/hr): ______

2. Product Weight (lbs/hr): ______

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Refer to PSD permit application documentation.

Name of Contaminant	Emission[1] Maximum lbs/hr	Emission[1] Actual T/yr	Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission lbs/yr	Potential[4] Emission T/yr	Relate to Flow Diagram

[1]See Section V, Item 2.

[2]Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3]Calculated from operating rate and applicable standard.

[4]Emission, if source operated without control (See Section V, Item 3).

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)

E. Fuels Refer to PSD permit application.

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
Natural Gas			
Fuel Oil			
Coal-Derived Gas			
Coal			

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis: Refer to PSD permit application.

Percent Sulfur: ______ Percent Ash: ______

Density: ______ lbs/gal Typical Percent Nitrogen: ______

Heat Capacity: ______ BTU/lb ______ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ______

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average Not applicable Maximum Not applicable

G. Indicate liquid or solid wastes generated and method of disposal.

See attached sheets.

G. Liquid and Solid Waste Generation and Disposal

Liquid Wastes	Disposal
Sanitary Wastes	Treated and sent to Cooling Pond
CC Wastewater	Treated and sent to Cooling Pond
CG Wastewater	Evaporated
Spent Solvents	Off-site disposal
Coal Pile Runoff/Leachate	Treated and sent to cooling pond
Slag Runoff/Leachate	Treated and sent to cooling pond
Sulfur Runoff	Treated and sent to cooling pond.

Solid Wastes	Disposal
Slag and fly slag	On-site storage
Sulfur	On-site storage
Intake Screen Debris	Returned to cooling pond.
Office wastes	Off-site disposal
Air Filters	Off-site disposal
Resin Beds	Off-site disposal
Spent Claus Catalyst	Off-site disposal

Refer to PSD permit application.

A. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: ____________ ft. Stack Diameter: ____________ ft.

Gas Flow Rate: ________ ACFM ________ DSCFM Gas Exit Temperature: ________ °F.

Water Vapor Content: ____________ % Velocity: ____________ FPS

SECTION IV: INCINERATOR INFORMATION

Not applicable.

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated							
Uncontrolled (lbs/hr)							

escription of Waste ____________

Total Weight Incinerated (lbs/hr) ________ Design Capacity (lbs/hr) ________

Approximate Number of Hours of Operation per day ______ day/wk ______ wks/yr. ______

Manufacturer ____________

Date Constructed ____________ Model No. ____________

	Volume $(ft)^3$	Heat Release (BTU/hr)	Fuel Type	Fuel BTU/hr	Temperature (°F)
Primary Chamber					
Secondary Chamber					

Stack Height: ________ ft. Stack Diamter: ________ Stack Temp. ________

Gas Flow Rate: ________ ACFM ________ DSCFM* Velocity: ________ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner

[ ] Other (specify) ____________

Brief description of operating characteristics of control devices: ____________

____

____

____

____

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

____

____

____

____

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]
   Not applicable.
2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made. Later.
3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).
   Refer to PSD permit application.
4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.) Refer to PSD permit application.
5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency). Refer to PSD permit application.
6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained. See Figure V-1
7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).
   See Figure 2-1 in PSD permit application.
8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.
   See Figure 2-2 and 2-3 in PSD permit application.

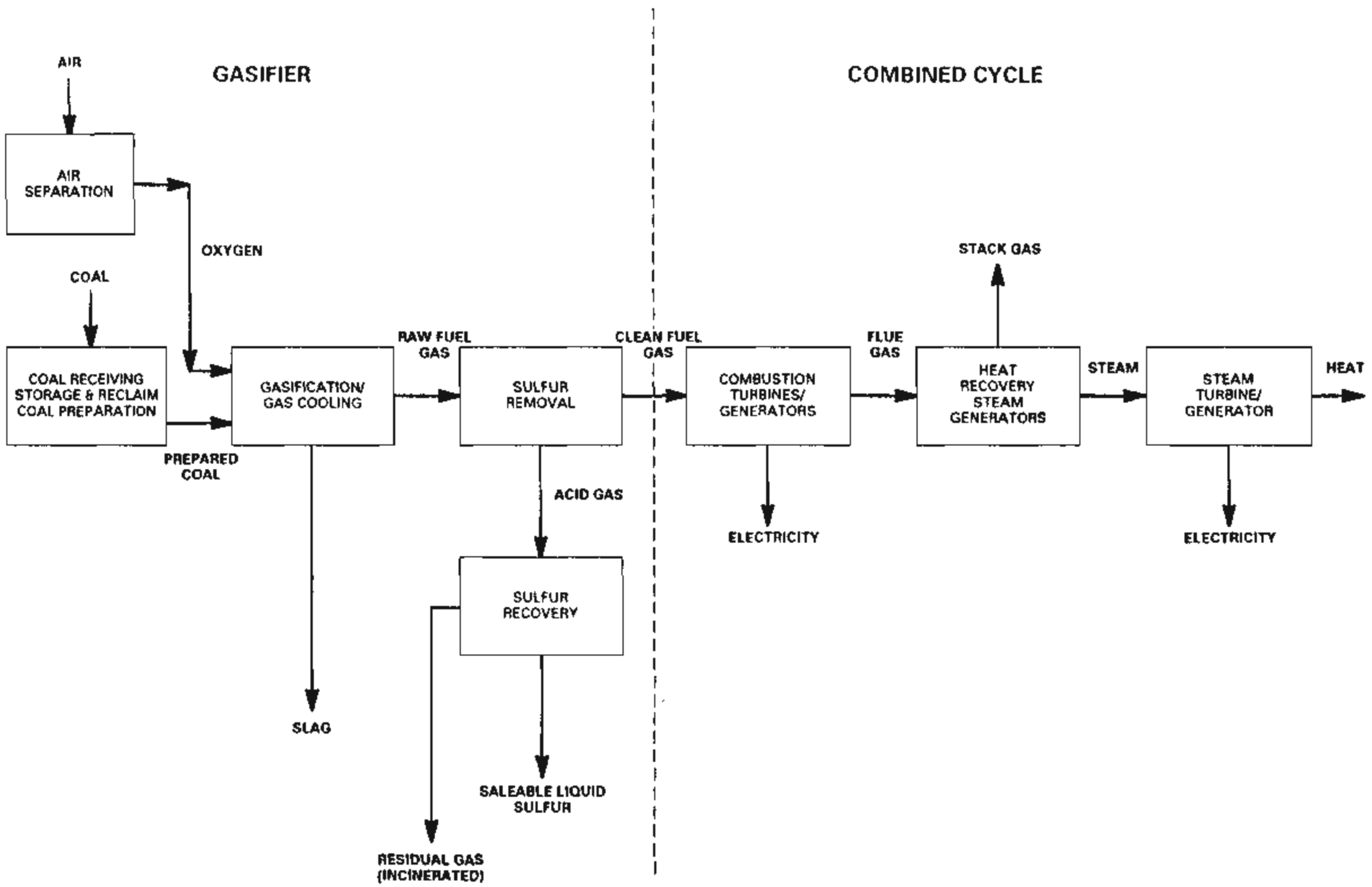


Figure V-1

TYPICAL COAL GASIFICATION/COMBINED-CYCLE PROCESS FLOW DIAGRAM

FPL

Martin CG/CC Project

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation. Not applicable.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

[X] Yes [ ] No 40 CFR 60 Subpart GG and Subpart J.

Contaminant	Rate or Concentration
See tables 2-1 - 2-8 in PSD permit application.	

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy)

[ ] Yes [X] No

Contaminant	Rate or Concentration
Refer to PSD permit application.	

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
See Table 4-2 in PSD permit application.	

D. Describe the existing control and treatment technology (if any). Not applicable

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:

*Explain method of determining

5. Useful Life:

6. Operating Costs:

7. Energy:

8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft.

b. Diameter: ft.

c. Flow Rate: ACFM

d. Temperature: °F.

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1. Refer to PSD permit application.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

[1]Explain method of determining efficiency.
[2]Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

3.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

4.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Costs:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected: See Table 4-2 in PSD permit applicatio

1. Control Device:

2. Efficiency:[1]

3. Capital Cost:

4. Useful Life:

5. Operating Cost:

6. Energy:[2]

7. Maintenance Cost:

8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City:

(4) State:

[1]Explain method of determining efficiency.
[2]Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

[1]Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data

1. 2 no. sites 2 PM_{10} 2 ( ) SO^2* 1 Wind spd/dir

Period of Monitoring 10 / 1 / 88 to 3 /13 / 89
month day year month day year

Other data recorded NO_x - 2 sites, O_3 - 2 sites, Ambient temperature, Sigma Theta, RH - 1 site

Attach all data or statistical summaries to this application.

Refer to attached Air quality/Meteorological Monitoring Data First & Second Quarter Reports.

*Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

a. Was instrumentation EPA referenced or its equivalent? [X] Yes [ ] No

b. Was instrumentation calibrated in accordance with Department procedures?

[X] Yes [ ] No [ ] Unknown

B. Meteorological Data Used for Air Quality Modeling

1. 5 Year(s) of data from 1 / 1 / 82 (month day year) to 12 / 31/86 (month day year)

2. Surface data obtained from (location) West Palm Beach, Florida

3. Upper air (mixing height) data obtained from (location) West Palm Beach, Florida

4. Stability wind rose (STAR) data obtained from (location) West Palm Beach, Florida

C. Computer Models Used

1. ISCST (UNAMAP 6, Version 3.4, 88348) Modified? No If yes, attach description.

2. ______ Modified? If yes, attach description.

3. ______ Modified? If yes, attach description.

4. ______ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables. Refer to PSD permit application documentation.

D. Applicants Maximum Allowable Emission Data Based on worst-case emissions scenario. See PSD permit application.

Pollutant	Emission Rate	
TSP	______	grams/sec
SO^2	______	grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time. Refer to PSD permit application.

F. Attach all other information supportive to the PSD review. Refer to PSD permit application.

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources. Refer to PSD permit application

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology. Refer to PSD permit application.

2.0 PROJECT DESCRIPTION

2.1 GENERAL DESCRIPTION

The proposed CG/CC Project will consist of the construction of four 400 MW coal gasification combined cycle units. Each combined cycle unit will consist of two combustion turbines and two heat recovery steam generators (i.e., a total of eight CTs and eight HRSGs for the four combined cycle units). Each CT will be served by a single HRSG, exhausting to an individual stack. There will be no HRSG bypass stacks for simple cycle operation; simple cycle operation will be accomplished by passing the exhaust gases through the HRSG and dumping steam from the HRSG directly to the condenser. The expected primary fuel is natural gas, with No. 2 distillate fuel oil as a backup. A coal gasification facility will be phased in later on, to serve as the source of fuel for the combined cycle units.

The proposed facility will include two 60,000 lb/hr (nominal) steam auxiliary boilers capable of firing natural gas and fuel oil and two 750 kW diesel generators firing diesel fuel. The auxiliary steam boilers will be used to serve the start-up steam needs of the four combined cycle units and the two emergency diesel generators will be used for in-plant power during loss of off-site power.

The coal gasification facility will serve as a source of medium Btu, low sulfur (less than 0.8% sulfur) coal-derived gas. The coal used in the gasification facility will have a maximum sulfur content of 4.3% and have a heating value of approximately 10,500 Btu/lb. The coal gasification plants will consist of coal and limestone receiving, storage and preparation facilities, gasifier, oxygen plant, product gas cleaning facilities and auxiliary equipment. The coal gasification facility will include four units, each capable of supporting 400 MW of combined cycle capacity. Each coal gasification unit will have two stacks, one flare stack used during start-up, shutdown and emergency conditions and one tail gas treating incinerator stack which will be used continuously.

The combined cycle units will utilize low sulfur fuel, steam injection NO_x controls and combustion controls for minimization of particulate matter, CO, and VOC emissions. The coal gasification facilities will utilize dry collection and wet suppression systems for control of particulate matter fugitive emissions from coal/limestone/slag handling and storage, wet particulate matter scrubbers for treatment of fuel gas particulates, and an absorption/stripping system for removal of sulfur compounds in the fuel gas product.

2.2 PROPOSED SOURCE EMISSIONS AND STACK PARAMETERS

The stack emissions and exhaust parameters that envelope the CT manufacturers' designs currently being considered for the project are presented in Tables 2-1 through 2-5. These tables cover the natural gas, No. 2 distillate fuel oil and coal-derived gas fuel scenarios for the CT units. Additionally, emissions data and stack parameters are summarized for the gasifier tail gas incinerator in Table 2-6, the auxiliary boilers in Table 2-7,and the emergency diesel generators in Table 2-8. Maximum annual potential emission rates for the proposed source with respect to regulated criteria air pollutants and regulated non-criteria air pollutants are presented in Table 2-9.

Worst-case air quality impacts due to the proposed facility are a function of emission rate and plume rise. Although it is not

Table 2-1. Combined Cycle Estimated Performance on Natural Gas at 40°F (Full Load, per CT/HRSG 200 MW Unit)

Conditions

Ambient Temperature (°F)	40
Compressor Inlet Temp. (°F)	40
Compressor Inlet RH (%)	60
Load Condition	Base (Full Load)
Elevation	31 ft. NGVD

Steam injection rate to limit NO_x to 42 ppmvd at 15% O_2

CT Emissions	ppm	lb/hr	g/sec	TPY
SO_2		91.5	11.5	401
PM		18.0	2.27	78.8
NO_x at 15% O_2	42	288.0	36.3	1261
CO	50	157.1	19.8	688
VOC(2)	1	1.8	0.227	7.88
Pb		neg.		
Be		neg.		
Hg		0.02	0.0025	0.09
As		neg.		
H_2SO_4		neg.(1)		
Cadmium		neg.		
Chromium		neg.		
Copper		neg.		
Formaldehyde		1.28	0.161	5.61
Manganese		neg.		
Nickel		neg.		
POM		0.0096	0.0012	0.042
Selenium		neg.		
Vanadium		neg.		
Zinc		neg.		

HRSG Parameters

HRSG Exhaust Temperature (°F)	280
HRSG Stack Height (ft.)	213.3
HRSG Stack Diameter (ft.)	20.0
HRSG Stack Gas Exit Velocity (ft/sec)	61.0

(1) Although gas turbine vendors may provide emissions estimates for H_2SO_4 they are not expected to be present in this form at stack conditions.

(2) Emissions estimates are exclusive of any background concentrations.

Sources: Bechtel, 1989, except forlead and noncriteria pollutant emissions (EPA 1988c).

Table 2-2. Combined Cycle Estimated Performance on Natural Gas at 95 (Full Load, per CT/HRSG 200 MW Unit)

Conditions

Ambient Temperature (°F)	95
Compressor Inlet Temp. (°F)	95
Compressor Inlet RH (%)	60
Load Condition	Base (Full Load)
Elevation	31 ft. NGVD

Steam injection rate to limit NO_x to 42 ppmvd at 15% O_2

CT Emissions	ppm	lb/hr	g/sec	TPY
SO_2		79.4	10.0	347.8
PM		16.7	2.10	73.1
NO_x at 15% O_2	42	242.9	30.6	1064
CO	50	134.9	17.0	591
VOC(2)	1	1.6	0.202	7.01
Pb		neg.		
Be		neg.		
Hg		0.018	0.0023	0.08
As		neg.		
H_2SO_4		neg.(1)		
Cadmium		neg.		
Chromium		neg.		
Copper		neg.		
Formaldehyde		1.12	0.141	4.91
Manganese		neg.		
Nickel		neg.		
POM		0.0084	0.0011	0.037
Selenium		neg.		
Vanadium		neg.		
Zinc		neg.		

HRSG Parameters

HRSG Exhaust Temperature (°F)	280
HRSG Stack Height (ft.)	213.3
HRSG Stack Diameter (ft.)	20.0
HRSG Stack Gas Exit Velocity (ft/sec)	54.1

(1) Although gas turbine vendors may provide emissions estimates for H_2SO_4 they are not expected to be present in this form at stack conditions.

(2) Emissions estimates are exclusive of any background concentrations.

Source: Bechtel, 1989.

Table 2-3. Combined Cycle Estimated Performance on No. 2 Distillate Fuel Oil at 40°F (Full Load, per CT/HRSG 200 MW Unit)

Conditions

Ambient Temperature (°F)	40
Compressor Inlet Temp. (°F)	40
Compressor Inlet RH (%)	60
Load Condition	Base (Full Load)
Elevation	31 ft. NGVD

Steam injection rate to limit NO_x to 65 ppmvd at 15% O_2

CT Emissions	ppm	lb/hr	g/sec	TPY
SO_2		919.8	115.9	4029
PM		60.6	7.6	265.4
NO_x at 15% O_2*	65	461.0	58.1	2019
CO	50	160.3	20.2	702.1
VOC(2)	6	11.0	1.39	48.2
Pb		0.017	0.0021	0.074
Be		0.019	0.0024	0.083
Hg		0.0043	0.00054	0.019
As		0.0074	0.00093	0.032
H_2SO_4		neg.(1)		
Cadmium		0.144	0.018	0.631
Chromium		0.672	0.085	2.94
Copper		3.92	0.494	17.17
Formaldehyde		5.68	0.716	24.9
Manganese		0.088	0.011	0.39
Nickel		2.40	0.302	10.5
POM		0.0039	0.0005	0.017
Selenium		0.328	0.041	1.437
Vanadium		0.96	0.121	4.20
Zinc		neg.		

HRSG Parameters

HRSG Exhaust Temperature (°F)	280
HRSG Stack Height (ft.)	213.3
HRSG Stack Diameter (ft.)	20.0
HRSG Stack Gas Exit Velocity (ft/sec)	61.7

(1) Although gas turbine vendors may provide emissions estimates for H_2SO_4 they are not expected to be present in this form at stack conditions.

(2) Emissions estimates are exclusive of any background concentrations.

*Based on fuel bound nitrogen content (N) < 0.02 %.

Source: Bechtel, 1989, except for lead and noncriteria pollutant emissions (EPA 1988c).

Table 2-4. Combined Cycle Estimated Performance on No. 2 Distillate Fuel Oil at 95°F (Full Load, per CT/HRSG 200 MW Unit)

Conditions

Ambient Temperature (°F)	95
Compressor Inlet Temp. (°F)	95
Compressor Inlet RH (%)	60
Load Condition	Base (Full Load)
Elevation	31 ft. NGVD

Steam injection rate to limit NO_x to 65 ppmvd at 15% O_2

CT Emissions	ppm	lb/hr	g/sec	TPY
SO_2		800.0	100.8	3504
PM		54.9	6.9	240.5
NO_x at 15% O_2*	65	392.1	49.4	1717
CO	50	135.7	17.1	594.4
VOC(2)	6	9.6	1.21	42.0
Pb		0.016	0.0020	0.070
Be		0.017	0.0021	0.074
Hg		0.0038	0.00048	0.017
As		0.0065	0.00082	0.028
H_2SO_4		neg.(1)		
Cadmium		0.128	0.016	0.561
Chromium		0.584	0.074	2.56
Copper		3.44	0.433	15.07
Formaldehyde		4.96	0.625	21.7
Manganese		0.080	0.010	0.35
Nickel		2.08	0.262	9.11
POM		0.0034	0.0004	0.015
Selenium		0.288	0.036	1.261
Vanadium		0.88	0.111	3.85
Zinc		neg.		

HRSG Parameters

HRSG Exhaust Temperature (°F)	280
HRSG Stack Height (ft.)	213.3
HRSG Stack Diameter (ft.)	20.0
HRSG Stack Gas Exit Velocity (ft/sec)	54.8

(1) Although gas turbine vendors may provide emissions estimates for H_2SO_4 they are not expected to be present in this form at stack conditions.

(2) Emissions estimates are exclusive of any background concentrations.

*Based on fuel bound nitrogen content (N) < 0.02 %.

Source: Bechtel, 1989, except for lead and noncriteria pollutant emissions (EPA 1988c).

Table 2-5. Combined Cycle Estimated Performance on Coal-Derived Gas at 75°F (Full Load, per CT/HRSG 200 MW Unit)

Conditions

Ambient Temperature (°F)	75
Compressor Inlet Temp. (°F)	75
Compressor Inlet RH (%)	60
Load Condition	Base (Full Load)
Elevation	31 ft. NGVD

Steam injection rate to limit NO_x to 42 ppmvd at 15% O_2

CT Emissions	ppm	lb/hr	g/sec	TPY
SO_2		834.0	105.1	3653
PM		19.0	2.39	83.2
NO_x at 15% O_2	42	392.0	49.4	1717
CO	50	202.4	25.5	886.5
VOC(2)	1	21.4	2.70	93.7
Pb		0.30	0.038	1.31
Be		0.00029	0.000036	0.0013
Hg		0.024	0.0030	0.105
As		0.017	0.0021	0.074
H_2SO_4		neg.(1)		
Cadmium		0.11	0.014	0.48
Chromium		1.99	0.25	8.72
Copper		0.53	0.067	2.32
Formaldehyde		neg.		
Manganese		0.26	0.033	1.14
Nickel		1.40	0.176	6.13
POM		neg.		
Selenium		0.23	0.029	1.01
Vanadium		neg.		
Zinc		14.36	1.81	62.9

HRSG Parameters

HRSG Exhaust Temperature (°F)	250
HRSG Stack Height (ft.)	213.3
HRSG Stack Diameter (ft.)	20.0
HRSG Stack Gas Exit Velocity (ft/sec)	65.9

(1) Although gas turbine vendors may provide emissions estimates for H_2SO_4 they are not expected to be present in this form at stack conditions.

(2) Emissions estimates are exclusive of any background concentrations.

*Based on fuel bound nitrogen content (N) <0.02 %.

Source: Bechtel, 1989, except for lead and noncriteria pollutant emissions (EPRI 1988).

Table 2-6. Tail Gas Incinerator Estimated Performance Data (Full Load, per incinerator)

Conditions

Ambient Temperature (°F)	75
Load Condition	Base (Full Load)
Elevation	31 ft. NGVD

CT Emissions	lb/hr	g/sec	TPY
SO_2	31.7	3.99	138.8
PM	neg.		
NO_x at 15% O_2	61.1	7.70	267.6
CO	neg.		
VOC	neg.		
Pb	0.05	0.0063	0.219
Be	0.00046	0.00006	0.002
Hg	0.0080	0.0010	0.035
As	0.0012	0.00015	0.0053
H_2SO_4	neg.		
Cadmium	0.003	0.00038	0.013
Chromium	0.99	0.125	4.34
Copper	0.068	0.0086	0.30
Formaldehyde	neg.		
Manganese	0.148	0.0186	0.648
Nickel	0.419	0.0528	1.84
POM	neg.		
Selenium	neg.		
Vanadium	0.0078	0.00098	0.034
Zinc	0.457	0.0576	2.00

Incinerator Stack Parameters

HRSG Exhaust Temperature (°F)	1200
HRSG Stack Height (ft.)	75.0
HRSG Stack Diameter (ft.)	7.5
HRSG Stack Gas Exit Velocity (ft/sec)	29.9

Source: Bechtel, 1989, except for lead and noncriteria pollutant emissions (EPRI 1988).

Table 2-7. Auxiliary Steam Boiler Estimated Emissions and Stack Parameters (Per 60,000 lb/hr Boiler)

Stack Height (ft)	60.0
Stack Exit Diameter (ft)	3.6

Natural Gas

Exhaust Stack Temperature (°F)	490.0
Stack Exit Velocity (ft/sec)	50.0

Emissions	lb/hr	g/sec	TPY
SO_2	neg.		
PM	0.5	0.063	2.19
NO_x	7.2	0.907	31.54
CO	3.6	0.454	15.77
VOC	0.3	0.038	1.31

Distillate Oil

Exhaust Stack Temperature (°F)	503.0
Stack Exit Velocity	50.0

Emissions	lb/hr	g/sec	TPY
SO_2	51.2	6.45	224
PM	1.4	0.176	6.1
NO_x	10.8	1.36	47.3
CO	3.6	0.454	15.8
VOC	0.14	0.018	0.61

Source: Bechtel, 1989.

Table 2-8. Emergency Diesel Generator Estimated Emissions and Stack Parameters (Per 750 kW Unit)

Exhaust Stack Temperature (°F)	955.0
Stack Exit Velocity (ft/sec)	130.0
Stack Height (ft)	25.0
Stack Exit Diameter (ft)	1.0

Emissions	lb/hr	g/sec	TPY
SO_2 (1.25 g/kW-hr)[1]	2.07	0.260	9.05
PM (1.34 g/kW-hr)[1]	2.22	0.279	9.70
NO_x (18.80 g/kW-hr)[1]	31.1	3.92	136.2
CO (4.06 g/kW-hr)[1]	6.71	0.846	29.4
VOC (1.50 g/kW-hr)[1]	2.48	0.313	10.9

(1) U.S. EPA AP-42 Emission Factors, Section 3.3.

Source: Bechtel, 1989.

Table 2-9. Summary of Potential Annual Emissions From the New Facility (TPY)[1]

	Four Combined Cycle Units (8 CT's)			Four Gasifier Incinerator Stacks	Two Auxiliary Steam Boilers		Two Diesel Generators	Fugitive Sources	Maximum[2] Total Emissions
	Natural Gas at 40°F	No. 2 Oil at 40°F	Coal Gas at 75°F		Natural Gas	No. 2 Oil			
Sulfur Dioxide	3,206	32,230	29,223	560.6	neg.	449	18.1	neg.	32,697
Particulate Matter	630.7	2,123	665.8	neg.	4.38	12.3	19.4	1,566	3,721
Nitrogen Oxides	10,092	16,153.4	13,736	1,068.7	63.1	94.6	272	neg.	16,485
Carbon Monoxide	5,505	5,617	7,092	neg.	31.5	31.5	58.8	neg.	7,182
Volatile Organic Compounds	63.1	385.4	749.9	neg.	2.63	1.23	21.7	neg.	774
Lead	neg.	0.6	10.6	0.88	neg.	neg.	neg.	neg.	11.5
Beryllium	neg.	0.60	0.01	0.008	neg.	neg.	neg.	neg.	0.60
Mercury	0.72	0.15	0.84	0.140	neg.	neg.	neg.	neg.	0.98
Inorganic Arsenic	neg.	0.26	0.60	0.021	neg.	neg.	neg.	neg.	0.62
Sulfuric Acid Mist									

(1) Maximum annual emissions for each unit correspond to operation at 100% capacity for 8,760 hours per year, using the maximum hourly emission rate for each emissions unit.

(2) Maximum total annual emissions are the sum of the underlined values for each pollutant. The underlined values reflect worst-case fuel for each process, excluding unrealistic cases (e.g., gasifier incinerators do not have emissions during oil-fired combined cycle operation).

practical to model all possible operating scenarios for the facility, a number of cases (combinations of operating conditions and fuel types) were examined to represent the range that will occur during actual operations.

The cases for combined cycle operation that were selected as having the potential to cause maximum impacts are:

Case	Fuel Type	Ambient Temperature
1	Natural Gas	40°F
2	Natural Gas	95°F
3	No. 2 Oil	40°F
4	No. 2 Oil	95°F
5	Coal Gas	75°F

The low (40°F) and high (95°F) ambient temperatures are reasonable points selected to indicate the influence of compressor inlet temperature on turbine performance and emissions/exhaust characteristics. The temperature for the coal gas case (75°F - approximately the mean annual temperature for the Martin site) represents the point of maximum design coal gas production capability. At temperatures above and below this point, gas production would probably fall below the amount required to fuel the gas turbines at full load; thus, the 75°F condition is estimated to represent the worst-case for coal gas operation of the units.

A review of the CT design information indicates that highest criteria air pollutant emission rates occur when burning No. 2 distillate fuel oil (SO_2, PM, and NO_x) and coal gas (CO, VOC, and Pb). Combustion of natural gas and No. 2 fuel oil result in similar exhaust gas flow rates and stack exit temperatures, which are directly related to plume rise. Firing of coal-derived gas results in a higher flow rate than natural gas or

No. 2 fuel oil, but a lower stack exit temperature and lower SO_2, PM and NO_x emission rates than No. 2 fuel oil. The lowest exhaust gas volumetric flow rate for the combined cycle units occurs under the 95°F ambient temperature condition. Since this condition results in potentially higher impacts due to lower plume rise of the exhaust gases than the 40°F ambient temperature case, combustion of natural gas and No. 2 fuel oil under the 95°F ambient temperature condition were also evaluated in the air quality impact analysis.

Because of their size, the proposed CT units are subject to federal New Source Performance Standards (NSPS) for gas turbines. The NSPS, described in Section 4.0, limits the emissions of SO_2 and NO_2. The fuel specifications for natural gas, No. 2 distillate fuel oil, coal, and coal-derived gas are presented in Tables 2-10 through 2-13, respectively.

2.3 EXISTING MARTIN UNITS 1 AND 2

There are currently two generating units operating at the Martin Site, each consisting of 863 MW of generation capacity. These units are capable of firing either natural gas or low-sulfur (less than or equal to 0.7% sulfur by weight) No. 6 fuel oil. Each of these units is served by a dedicated stack. The stack parameters and air pollutant emission rates for these existing units are presented in Table 6-15 (located in Section 6.0).

Table 2-10. Natural Gas Analysis

Analysis	Mole (%)
Nitrogen	0.67
Carbon Dioxide	0.71
Methane	95.61
Ethane	2.37
Propane	0.36
Iso-Butane	0.08
Normal-Butane	0.08
Iso-Pentane	0.04
Normal-Pentane	0.02
Hexanes Plus	0.06
Total	100.00
Specific Gravity	0.5848
Saturated Btu at 14.73	1014
Dry Btu at 14.73	1032
Alarm Code	0

Quality Information	Parameters
Heating Value (HHV)	23,803 Btu/lb
Total Sulfur (maximum)	200 gr/Mft^3 = 0.07%
Hydrogen Sulfide (maximum)	15 gr/Mft^3

Source: FPL, 1989.

Table 2-11. No. 2 Distillate Fuel Oil Analysis

Quality	Test Method ASTM	Minimum	Typical	Maximum
Sulfur, (% by Wt.)	D 129	-	-	0.50
Flash Point, Pensky-Martin, (°F)	D 93	140	-	-
Pour Point, (°F)	D 97	-	-	15
Water and Sediment, (% Vol.)	D 95 & D 473	-	-	0.05
Ash, (%) D 482	-	0.01	0.05	
Viscosity, (SSU at 100 °F)	-	-	36	40
Gravity, (°API)	D 287	30	32-34	40
Total Metals, (ppm)	-	-	-	2.0
Vanadium, (ppm)	D 1548	-	-	0.50
Carbon Residue on 10% Bottoms	D 524	-	0.15	0.35
Distillation Temperature, (°F)				
90% Point, (°F)	D 86	540	590-610	640
End Point, (°F)	D 86	-	640-680	690
Color	D 1500	-	-	1.5
Corrosion, Copper Strip, (3 Hr. at 122 °F)	D 130	-	-	1
Neutrality	-	-	Neutral	-
Cetane Number	D 613	40	-	-
Heat of Combustion (HHV), (Btu/lb)	D 240-76	-	-	19,739

Source: FPL, 1989.

Table 2-12. Coal Analysis

Proximate Analysis (percent "as-received")

	Range Specified	
	Minimum	Maximum
Moisture	4.0	15.0
Ash	6.0	18.0
Volatile Matter	23.0	40.0
Fixed Carbon	37.0	(no upper limit)

Ultimate Analysis (percent "as-received")

	Range Specified	
	Minimum	Maximum
Moisture	4.0	15.0
Carbon	49.3	79.0
Hydrogen	3.4	5.8
Nitrogen	0.9	1.9
Chlorine	0.0	0.3
Sulfur	0.5	4.3
Ash	6.0	18.0
Oxygen	3.4	9.8

Heating Value (HHV) - 10,500 Btu/lb (minimum)

Source: FPL, 1989.

Table 2-13. Coal-Derived Gas Analysis

Constituent	Percent By Volume
CO	45 - 50
CO_2	1 - 13
H_2	31 - 39
CH_4	0.03 - 0.3
N_2 + AR	2 - 4
H_2S + COS	0.05

Heating Value (HHV) - 5,560 - 7,610 Btu/lb.

Source: Bechtel, 1989.

2.4 SITE LAYOUT AND STRUCTURES

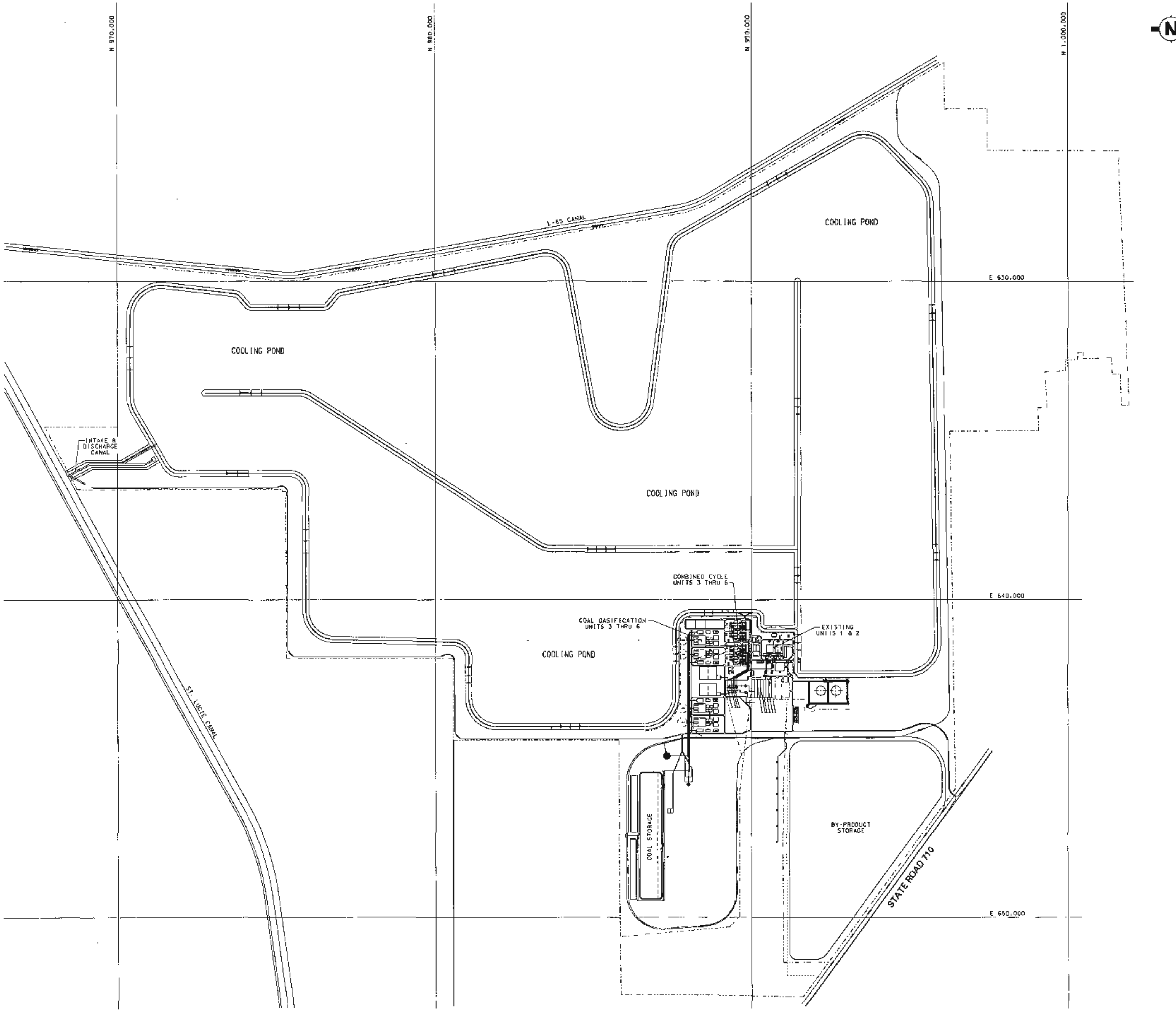
A base map showing the existing site facilities, including Martin Units 1 and 2, is presented as Figure 2-1.

Figure 2-2 depicts the proposed site layout showing the new facilities which will occupy approximately 1300 acres of the site. Figure 2-3 shows the coal gasification facilities and the Martin combined cycle units 3, 4, 5 and 6 layout at a larger scale for clarity. Detailed footprints of the combined cycle and gasifier areas are included as Figures 2-4 and 2-5, respectively. The dimensions and elevations shown on the referenced figures are preliminary and may change as detailed engineering design proceeds. However, the relative dimensions and elevations are expected to remain similar.

As shown in Figure 2-2, the proposed Units 3-6 will be located about 1500 feet south of the existing Martin Units 1 and 2. The proposed new units will not interface with the existing units; there are no shared facilities, with the exception of the main access road, pipelines, rail facilities, cooling pond and electrical transmission system.

All coal gasifying and power generating structures are to be located west of the existing access road. The coal, limestone, and slag handling areas will be located to the east of the existing access road. A new on-site railroad loop will be added to facilitate coal and limestone delivery to the site. The existing switchyard will be modified to accommodate the distribution of electric power generated by the proposed project.

Figure 2–1
MARTIN CG/CC SITE

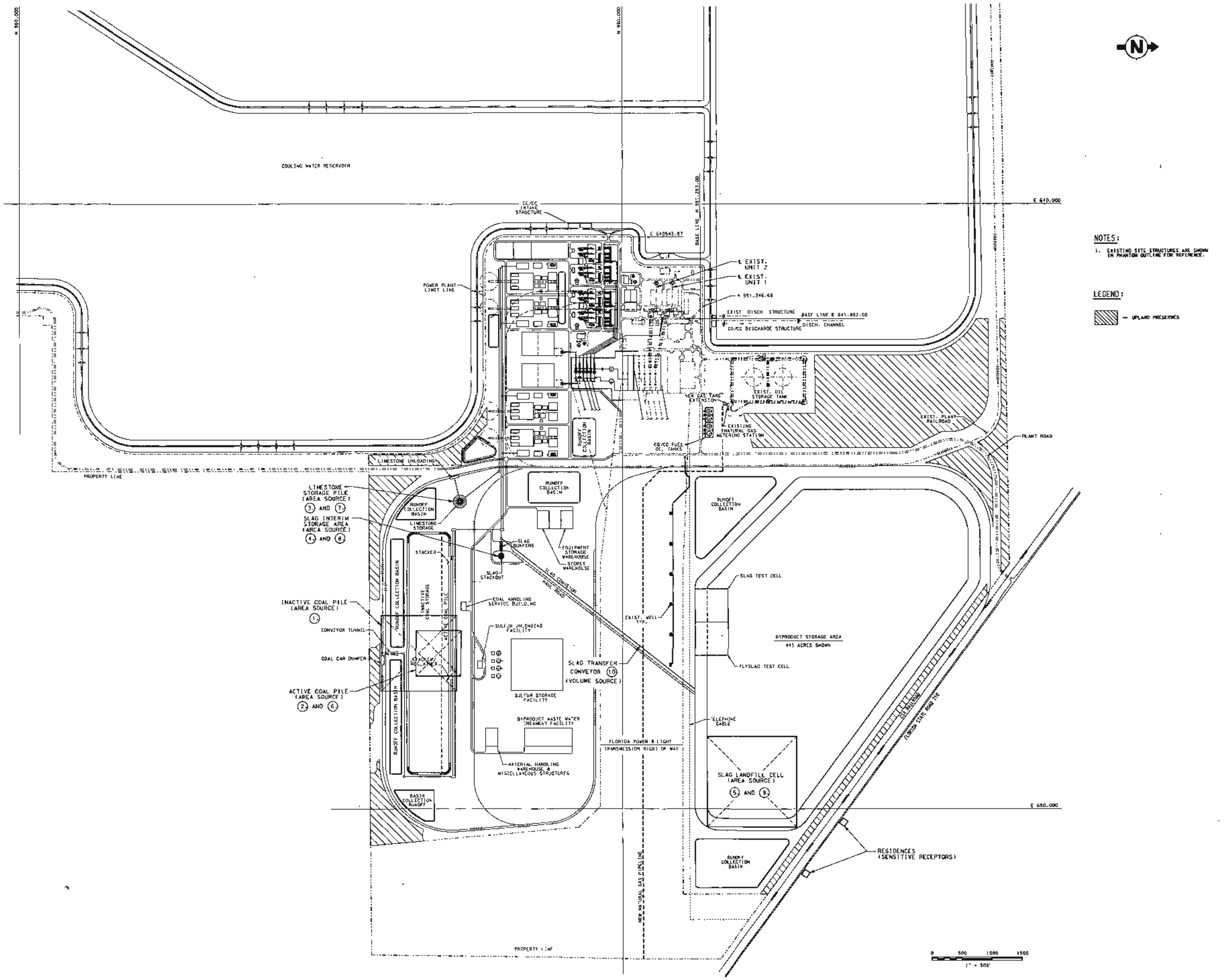


SOURCE: BECHTEL POWER CORPORATION, 1989

Martin
CG/CC
Project
FPL

Figure 2–2

SITE LAYOUT FOR PROPOSED CG/CC FACILITIES

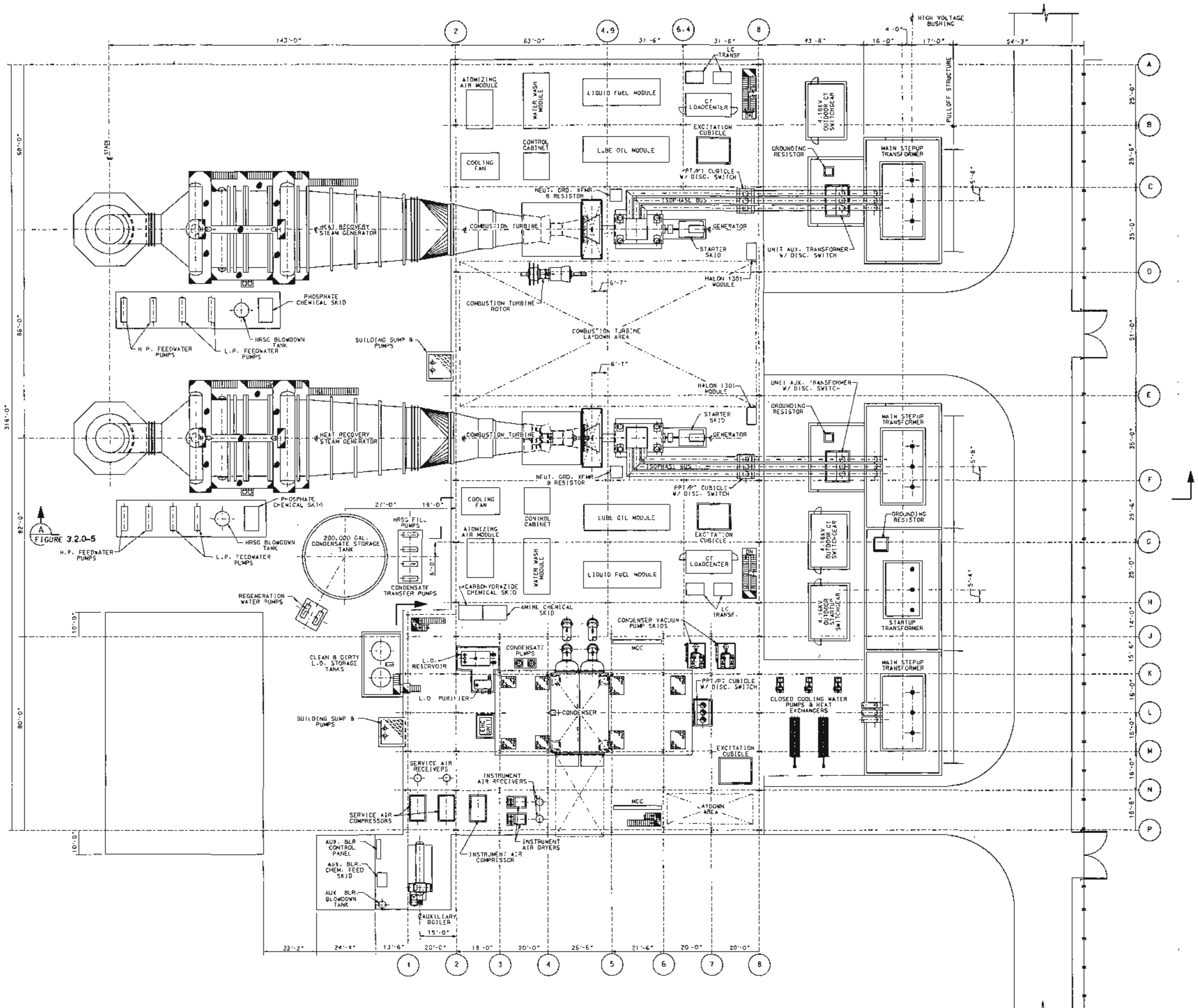


SOURCE: BECHTEL POWER CORPORATION, 1989

Martin CG/CC Project

FPL

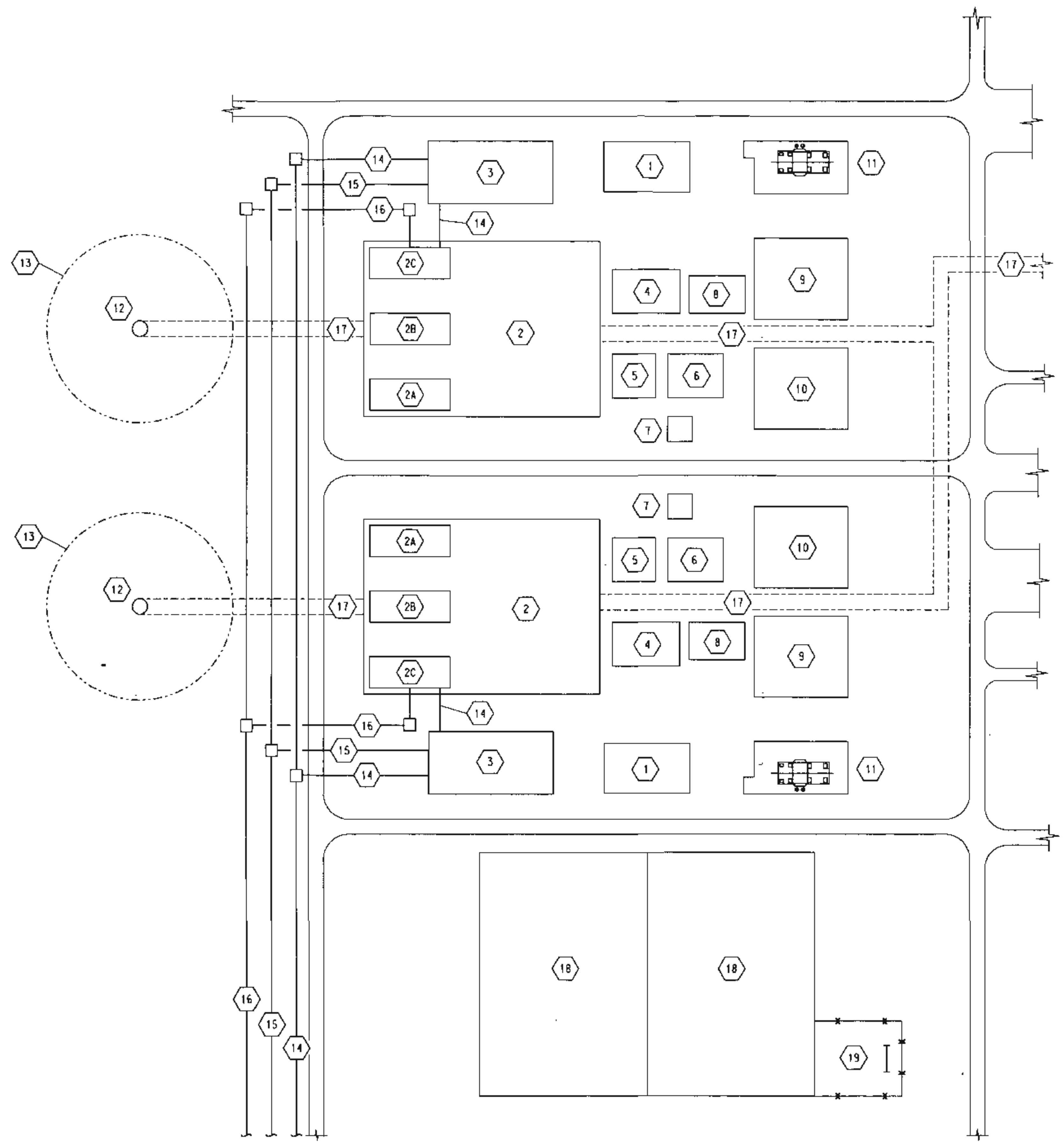
Figure 2–4
CC UNIT
LAYOUT



SOURCE: BECHTEL POWER CORPORATION, 1989

Martin
CG/CC
Project
FPL

Figure 2-5
CG UNIT
LAYOUT



LEGEND

1. CONTROL ROOM
2. COAL GASIFICATION
2A. TRAIN "A"
2B. TRAIN "B"
2C. TRAIN "C"
3. COAL PREPARATION
4. TAIL GAS TREATMENT
5. ACID GAS REMOVAL
6. SULFUR RECOVERY
7. SULFUR LOADING
8. PROCESS WATER TREATMENT
9. EFFLUENT WATER TREATMENT CLARIFIERS
10. EFFLUENT WATER BIOTREATMENT
11. STEAM TURBINE
12. FLARE STACK
13. FLARE STACK EXCLUSION AREA
14. COAL CONVEYOR
15. LIMESTONE CONVEYOR
16. SLAG CONVEYOR
17. PIPE RACK
18. OXYGEN PLANT
19. SUBSTATION

SOURCE: BECHTEL POWER CORPORATION, 1989

Martin
CG/CC
Project

FPL

3.0 AIR QUALITY REVIEW REQUIREMENTS AND APPLICABILITY

The following discussion pertains to the federal and state air regulatory requirements and their applicability to the Martin CG/CC Project. These regulations must be satisfied before the proposed facility can be constructed and begin operation.

3.1 NATIONAL AND FLORIDA AMBIENT AIR QUALITY STANDARDS (NAAQS/FAAQS)

The applicable federal and state ambient air quality standards are presented in Table 3-1. The primary NAAQS/FAAQS were promulgated to protect the public health, and the secondary NAAQS/FAAQS were promulgated to protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air. Areas of the country in violation of the NAAQS are designated by EPA as non-attainment areas, and new or modified existing sources to be located in or near these areas may be subject to stringent air quality permitting requirements.

3.2 PSD REVIEW REQUIREMENTS

General Requirements. Under the federal PSD permit review requirements, all major new or modified existing sources of air pollutants located in attainment areas and regulated under the Clean Air Act (CAA) must be reviewed and approved by EPA. PSD permit review authority has been delegated to Florida DER by EPA for sources located in Florida.

A "major stationary source" is defined as any one of 28 specified source categories which has the potential to emit 100 tons per year or more, or any other stationary source which has the potential to emit 250 tons per year or more of any air

Table 3-1. Ambient Air Quality Standards and PSD Increments

Pollutant	Averaging Time	Federal NAAQS ($\mu g/m^3$)	Florida AAQS ($\mu g/m^3$)	Class I PSD Increment ($\mu g/m^3$)	Class II PSD Increment ($\mu g/m^3$)
PM[1]	24-hour	150	150	10	37
	Annual	50	50	5	19
SO_2	3-hour	1300[2]	1300[2]	25	512
	24-hour	365	260	5	91
	Annual	80	60	2	20
NO_2	Annual	100	100	2.5	25
CO	1-hour	40,000	40,000	-	-
	8-hour	10,000	10,000	-	-
Ozone	1-hour	235	235	-	-
Lead	Calendar Quarter	1.5	1.5	-	-

[1] Ambient air quality standards are based on PM_{10} and PSD increments are based on total suspended particulates (TSP) until such a time as EPA promulgates PM_{10} PSD increments. On October 5, 1989, EPA proposed increments of 8 $\mu g/m^3$ (24-hr) and 4 $\mu g/m^3$ (annual) for class I areas and 30 $\mu g/m^3$ (24 -hr) and 17 $\mu g/m^3$ (annual) for Class II areas (FR 1989). PM_{10} ambient standard and PM PSD increment impacts were evaluated based on TSP modeled impacts.

[2] The 3-hour average SO_2 ambient air quality standard is a secondary (welfare-related) standard. All of the other Federal and Florida ambient air quality standards are primary (health-related) standards.

Sources: CFR, 1987
U.S. EPA, 1980a

pollutant regulated under the CAA. The term "potential to emit" means the capability, at maximum design capacity, to emit a pollutant after the application of control equipment. The existing FPL facility, consisting of Martin Units 1 and 2, is a major source since emissions of several pollutants exceed 100 tons per year from these fossil fuel fired steam electric plants (one of the 28 source categories specified).

A "major modification" is defined under the PSD regulations as a change at an existing major stationary source which results in net increases in emissions by greater than "significant" amounts. The PSD significant emission rates are shown in Table 3-2 for all criteria and non-criteria air pollutants regulated under PSD.

PSD review is used to determine whether significant air quality deterioration will result from the new or modified source located in an attainment area. The PSD regulations are contained in 40 CFR 52.21, Prevention of Significant Deterioration of Air Quality. Major sources and modifications are required to undergo the following analyses under PSD for each air pollutant emitted in significant quantities:

- o A control technology analysis,
- o An air quality impacts analysis, and
- o An additional impacts analysis.

In addition to these analyses, a new source must also be reviewed with respect to Good Engineering Practice (GEP) stack height regulations (U.S. EPA, 1985a).

PSD Increments/Classifications. In promulgating the 1977 CAA Amendments, Congress specified that certain increases above an air quality "baseline concentration" level for SO_2 and PM

Table 3-2. Comparison of Proposed Facility Criteria and Regulated Non-Criteria Air Pollutant Emissions with PSD Significant Emission Rates

Pollutant	Emissions[(1)] (TPY)	PSD Significant Emission Rate (TPY)
Sulfur Dioxide	33,696	40
Particulate Matter (TSP)	3,721	25
Particulate Matter (PM_{10})	3,721	15
Nitrogen Dioxide	520	40
Carbon Monoxide	7,182	100
Volatile Organic Compounds	774	40
Lead	11.4	0.6
Sulfuric Acid Mist	neg.	7.0
Total Fluorides	2.0	3.0
Total Reduced Sulfur	neg.	10.0
Reduced Sulfur Compounds	neg.	10.0
Hydrogen Sulfide	neg.	10.0
Asbestos	neg.	0.007
Beryllium	0.67	0.0004
Mercury	0.98	0.100
Vinyl Chloride	neg.	1.0
Benzene	neg.	0
Radionuclides	neg.	0
Radon-222	neg.	0
Inorganic Arsenic	0.62	0

(1) Worst case emission estimates are based on the worst case fuel and operating scenario for each pollutant (refer to Table 2-9).

Sources: U.S. EPA, 1980a
U.S. EPA, 1980b
Bechtel, 1989

concentrations would constitute "significant deterioration." The magnitude of the allowable increment depends on the classification of the area in which a new source (or modification) will be located or have an impact. Three classifications were designated based on criteria established in the CAA Amendments. Initially, Congress designated PSD areas as Class I (international parks, national wilderness areas, and memorial parks larger than 5,000 acres, and national parks larger than 6,000 acres) or as Class II (all areas not designated as Class I). No Class III areas, which would allow greater deterioration than Class II areas, were designated. EPA subsequently incorporated the requirements for classifications and area designation into the PSD regulations.

On October 17, 1988, the EPA promulgated regulations to prevent significant deterioration due to NO_2 emissions and established PSD increments for NO_2 concentrations. The allowable PSD increments were presented in Table 3-1. The Florida DER has adopted the EPA PSD classification scheme and the allowable PSD increments for SO_2 and PM, but has not yet adopted the NO_2 increments.

The term "baseline concentration" is derived from federal and state PSD regulations and denotes a concentration level corresponding to a specified baseline date and certain additional baseline sources. The PSD regulations, as amended August 7, 1980, define baseline concentration as the ambient concentration level which exists in the baseline area at the time of the applicable baseline date. A baseline concentration is determined for each pollutant for which PSD increments are promulgated and a baseline date is established. The baseline concentration includes:

1. The actual emissions representative of sources in existence on the applicable baseline date; and

2. The allowable emissions of major stationary sources which commenced construction before January 6, 1975, for SO_2 and PM (TSP) concentrations, or before February 8, 1988, for NO_2 concentrations, but which were not in operation by the applicable baseline date.

The following emissions are not included in the determination of baseline concentration and consume PSD increment:

1. Actual emissions from any major stationary source (greater than 100 tons/year emissions) on which construction commenced after January 6, 1975 for SO_2 and TSP, and after February 8, 1988, for NO_2; and

2. Actual emissions from any minor stationary source (less than 100 tons/year emissions) on which construction commenced after December 27, 1977 for SO_2 and TSP, and after February 8, 1988 for NO_2.

The term "baseline date" actually includes three different dates:

1. The major source baseline date, which is January 6, 1975 in the cases of SO_2 and PM (TSP), and February 8, 1988, in the case of NO_2; and

2. The minor source baseline date, which is December 27, 1977, in the cases of SO_2 and PM (TSP), and February 8, 1988, in the case of NO_2.

Control Technology Review. The control technology review requirements of the federal PSD regulations require that all applicable federal and state emission limiting standards be met and that Best Available Control Technology (BACT) be applied to control emissions from the source. The BACT requirements apply to all applicable regulated and unregulated air pollutants for which the increase in emissions from the source or modification exceeds significant emission levels.

BACT is defined in 40 CFR 52.21 as:

> An emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Act...which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable... through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant... If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emission unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology.

The requirements for BACT were incorporated within the PSD framework in the 1977 CAA amendments [Public Law 95-95; Part C, Section 165(a)(4)]. The primary purpose of BACT is to minimize consumption of PSD increments and thereby increase the potential for future economic growth without significantly degrading air quality (U.S. EPA, 1980a). Guidelines for the evaluation of BACT can be found in the "PSD Workshop Manual" (U.S. EPA, 1980b). These guidelines were issued by EPA to provide a consistent approach to BACT and to ensure that the impacts of alternative emission control systems are measured by the same set of parameters. In addition, through implementation of these guidelines, BACT is determined on a case-by-case basis and BACT for a source in one area may not be the same for an identical source located in another area. BACT analyses for the same types of emissions unit and the same pollutants in different locations or situations may determine that different control strategies should be applied to the different sites, depending on site-specific factors.

The BACT requirements are intended to ensure that the control systems incorporated in the design of a proposed facility reflect the latest in control technologies used in a particular industry and take into consideration existing and future air quality in the vicinity of the proposed facility. BACT must, at a minimum, demonstrate compliance with NSPS for a source (if applicable). An evaluation of the air pollution control techniques and systems, including a cost-benefit analysis of alternative control technologies capable of achieving a higher degree of emission reduction than the proposed control technology, is required. The cost-benefit analysis requires the documentation of the materials, energy, and economic penalties associated with the proposed and alternative control systems, as well as the environmental benefits derived from these systems. A determination of BACT is to be based on sound judgement, balancing environmental benefits with energy, economic, and other impacts.

Ambient Air Quality Monitoring Requirements. In accordance with the requirements of 40 CFR 52.21(m), any application for a PSD permit must contain an analysis of continuous ambient air quality monitoring data in the area affected by the proposed major stationary source or major modification. For a major modification, the applicable pollutants are those for which the net emissions increase exceeds the significant emission rates shown in Table 3-2.

According to EPA's "Ambient Monitoring Guidelines for Prevention of Significant Deterioration (U.S. EPA, 1987c), ambient air monitoring for a period of up to 1 year is generally appropriate to satisfy the PSD monitoring requirements. A minimum of four (4) months of data is required. Existing data from the vicinity of the proposed source may be utilized if the data meet certain quality assurance requirements; otherwise, additional data may need to be gathered. Guidance in designing a PSD ambient air monitoring network is provided in U.S. EPA (1987c).

The PSD regulations include an exemption which excludes or limits the pollutants for which an air quality analysis must be conducted. This exemption states that the Administrator may exempt a proposed major stationary source or major modification from the monitoring requirements of 40 CFR 52.21(m) with respect to a particular pollutant if the emissions increase of the pollutant from the source or modification would cause, in any area, air quality impacts less than the de minimis air quality impact levels presented in Table 3-3.

Source Impact Analysis. A source impact analysis must be performed for a proposed major source subject to PSD for each pollutant for which the increase in emissions exceeds the significant emission rate. The PSD regulations specifically

Table 3-3 PSD De Minimis Ambient Air Quality Impact Levels

Pollutant	Air Quality Impact De Minimis Level ($\mu g/m^3$) and Averaging Time(1)
Carbon monoxide	575 (8-hour)
Nitrogen dioxide	14 (Annual)
Sulfur dioxide	13 (24-hour)
Particulate Matter (TSP)	10 (24-hour)
Particulate Matter (PM_{10})	10 (24-hour)
Ozone	(2)
Lead	0.1 (3-month)
Asbestos	(3)
Beryllium	0.001 (24-hour)
Mercury	0.25 (24-hour)
Vinyl chloride	15 (24-hour)
Fluorides	0.25 (24-hour)
Sulfuric acid mist	(3)
Total reduced sulfur (including H_2S)	(3)
Reduced sulfur (including H_2S)	(3)
Hydrogen sulfide	0.2 (1-hour)

(1) Ambient air quality monitoring requirements for applicable pollutants may be exempted if the impact of the net increase in emissions is below the applicable air quality impact de minimis levels.

(2) No specific air quality impact de minimis level is prescribed for ozone. Exemptions are granted when a proposed source's VOC emissions are less than 100 tons/year.

(3) No acceptable monitoring techniques available at this time. Therefore, monitoring is not required until acceptable techniques are available.

Source: U.S. EPA, 1987c.

require the use of atmospheric dispersion models in performing air quality impact analysis, estimating baseline and future air quality levels, and determining compliance with NAAQS/FAAQS and allowable PSD increments. Reference EPA models must normally be used in performing the impact analysis. Use of non-reference EPA models requires EPA's consultation and prior approval. Guidance for the regulatory application of dispersion models is presented in the U.S. EPA "Guideline on Air Quality Models (Revised)" (U.S. EPA, 1987).

Additional Impacts Analysis. In addition to air quality impact analyses, federal PSD regulations require analyses of the impairment to visibility and the impacts on soils and vegetation that would occur as a result of the proposed source. These analyses are to be conducted primarily for PSD Class I areas. Impacts due to general commercial, residential, industrial, and other growth associated with the source must also be addressed. These analyses are required for each pollutant emitted in significant quantities.

Good Engineering Practice (GEP) Stack Height. The 1977 Clean Air Act Amendments require under Section 123 that the degree of emission limitation required for control of any air pollutant not be affected by a stack height that exceeds GEP, or any other dispersion technique. On July 8, 1985, EPA promulgated final stack height regulations (U.S. EPA, 1985a).

The EPA's final stack height regulations define GEP stack height as the greater of:

(1) 65 meters, measured from the ground-level elevation at the base of the stack; or

(2) (a.) For stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR Parts 51 and 52,

$$H_g = 2.5 H,$$

provided the owner or operator produces evidence that this equation was actually relied on in establishing an emission limitation;

(b.) For all other stacks,

$$H_g = H + 1.5 L$$

where: H_g = GEP stack height, measured from the ground-level elevation at the base of the stack,
H = height of nearby structure(s) measured from the ground-level elevation at the base of the stack,
L = lesser dimension, height or projected width of nearby structure(s),

provided that the EPA, state or local air pollution control agency may require the use of a field study or fluid model to verify GEP stack height for the source; or

(3) The height demonstrated by a fluid model or a field study approved by the EPA, State, or local air pollution control agency, which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash, wakes, or eddy effects created by the source itself, nearby structures or nearby terrain features.

U.S. EPA (1985a) defines a stack height of 65 meters as the de minimis GEP stack height which is the maximum stack height credit that can be considered to be GEP without justification.

The term "nearby" is defined by the GEP stack height regulations as a distance up to five times the lesser of the height or width dimensions of a structure or terrain feature, but not greater than 0.8 km. Although GEP stack height regulations require that the stack height credit used in modeling for determining compliance with NAAQS/FAAQS and PSD increments not exceed the GEP stack height, the actual stack height may be greater.

The GEP stack height regulations also allow increased stack height credit beyond that resulting from the above formula in cases where "plume impaction" occurs. Plume impaction is defined as concentrations measured or predicted to occur when the plume interacts with "elevated terrain." "Elevated terrain" is defined as terrain which exceeds the height calculated by the GEP stack height formula. Because the terrain in the vicinity of the Martin Site is flat, plume impaction was not considered in determining the GEP stack height for the proposed source.

3.3 SOURCE APPLICABILITY

Pollutant Applicability. The EPA PSD regulations (U.S. EPA, 1980a) apply to the proposed generation expansion project due to the attainment status for the Martin Site with respect to all criteria air pollutants. Martin County and the surrounding counties are designated as PSD Class II areas for SO_2, PM (TSP) and NO_2. The Martin Site is located approximately 145 km north of the Everglades National Park, the nearest PSD Class I area.

Pollutant applicability for the proposed facilities is addressed in Sections 2.0 and 4.0 and briefly summarized here. The proposed modification is considered to be a major modification under the PSD regulations since the existing Martin Units 1 and 2 constitute a major stationary source. PSD review is required for any regulated pollutant for which the net increase in emissions exceeds the PSD significant emission rates presented in Table 3-2. As shown, the net increase in potential emissions for the proposed facilities will exceed the PSD significant emission rates for the following regulated pollutants: SO_2, PM, NO_2, CO, VOC, Pb, beryllium (Be), mercury (Hg), and inorganic arsenic (As). The proposed modification is subject to PSD review for these pollutants.

Ambient Air Quality Monitoring. Based upon the net increase in emissions from the proposed facility presented in Table 3-2, a PSD preconstruction ambient air monitoring analysis is required, as part of the air quality impact analysis for SO_2, PM_{10}, NO_2, CO, Ozone (O_3), lead (Pb), Be, Hg and As. However, if the net increase in a source's impact of a pollutant is less than the de minimis air quality impact level, then an exemption from the preconstruction ambient air quality monitoring requirement may be granted for that pollutant. In addition, if an acceptable ambient air monitoring method for the pollutant has not been established by EPA, monitoring is not required.

Prior to commencement of preconstruction ambient air quality monitoring, a preliminary modeling was done to indicate those pollutants which could be exempted from the monitoring requirement. As verified by the revised modeling analysis described in Sections 6.0 and 7.0, the increases in air quality impacts for CO, Pb, and Hg are predicted to fall below the de minimis impact levels presented in Table 3-3. There are no EPA approved PSD protocol ambient monitoring methods for As or Be. Therefore, monitoring was not required for Pb, CO, Be, Hg, and As. As a result, a preconstruction ambient monitoring analysis was performed for SO_2, NO_2, PM_{10}, and Ozone. The air quality impact analysis results for these pollutants are presented in Section 7.0.

Proposed Source GEP Stack Height Impact Analysis. The proposed source was modeled using GEP stack height credit. The following discussion presents the assumptions used in calculating the GEP stack height applied in the modeling analysis for the proposed source.

The Martin Site, as modified by the proposed CG/CC project will be comprised of the following building structures which need to be addressed in the GEP stack height analysis:

- Existing Units 1 and 2 boiler structures,
- Eight combined cycle combustion turbines and associated HRSG structures,
- Two CG/CC plant control building structures,
- Two oxygen plant structures, and
- Four coal gasification plant structures.

Each of the structures listed above was evaluated individually for adverse aerodynamic downwash influence on the HRSG stacks and the coal gasification plant tail gas treatment incinerator stacks. The exception was the existing Units 1 and 2 boiler structures which were combined into one structure since EPA's Guideline for Determination of Good Engineering Practice Stack Height (U.S. EPA, 1985) indicates that structures located beside each other should be considered as one structure if their distance of separation is less than the smallest dimension (height or projected width) for either structure.

The building dimensions for each of the structures listed above are based on preliminary design data and are presented in Table 3-4.

All of the building structures specified above are squat structures because the projected width is greater than the height for each case. The lesser dimension (L) for each case is the height. The exception is the oxygen plant structures which are tall structures. The lesser dimension for GEP stack height calculation in this case would be the projected width of the oxygen plant structure, should the stacks be located within the area of influence for those structures.

A May 11, 1988 U.S. EPA policy memorandum (U.S. EPA, 1988) defines the area of influence of a building for wake effects calculations as 2L in the <u>upwind</u> direction, 5L in the <u>downwind</u> direction, and one-half L in the <u>crosswind</u> direction, where L is the lesser of the projected building width and height for that wind direction. The components for each structure's area of influence are presented in Table 3-5.

An analysis of all applicable building structures' area of influence in relation to the location of the HRSG and coal gasification plant tail gas treatment incinerator stacks was performed. The results of the analysis indicated that the HRSG stacks are located within the area of influence for the CG/CC plant control buildings and the HRSG structures. The coal gasification plant tail gas treatment incinerator stacks are located within the area of influence for the coal gasification plant building structures. The GEP stack height calculations for the HRSG and tail gas treatment incinerator stacks are based on the formula:

$$H_g = H + 1.5\ L \qquad (1)$$

Table 3-4. Building Structure Dimensions for Martin Site[1]

Structure	Width (m)	Projected Width (m)	Length (m)	Height (m)
Units 1 and 2 boilers (separate)	57.3	68.2	36.9	57.9
Units 1 and 2 boilers (combined)	36.9	151.0[2]	146.4[3]	57.9
Each HRSG	10.8	21.5	18.6	17.4
Each CG/CC plant control building	19.8	36.4	30.5	18.3
Each oxygen plant	4.6	9.1	7.6	45.7
Each coal gasification plant	83.8	141.7	114.3	12.2

[1] The building structure dimensions are based on preliminary design data with the exception of existing Units 1 and 2 boilers which are as constructed.

[2] Assuming northwest and northeast winds, the projected width for the existing Units 1 and 2 boilers (combined) indicate the building to be a squat structure.

[3] There is an 24.4 m separation distance between Units 1 and 2 which is included in the overall length of the combined structures.

Source: Ebasco, 1989.

Table 3-5. Building Structure Area of Influence

Structure	L[1] (m)	1/2 L (m)	2 L (m)	5 L (m)
Units 1 and 2 boiler rooms (combined)	57.9	29.0	115.8	289.5
Each HRSG	17.4	8.7	34.8	87.0
Each CG/CC plant control building	18.3	9.2	36.6	91.5
Each oxygen plant	9.1	4.6	18.2	45.5
Each coal gasification plant	12.2	6.1	24.4	61.0

[1] The height dimensions from Table 3-4 were determined to be the lesser dimensions for the building structures being considered in the GEP stack height analysis since these structures are squat structures (e.g., the projected width is greater than the height for each applicable structure). The exception was the oxygen plant structures which are tall structures and the projected width is the lesser dimension.

Source: Ebasco, 1989.

where: H_g = GEP stack height.

H = Height of the constraining structure.

L = Lesser dimension (height or projected width) of the structure.

Because all applicable building structures (within the area of influence of one or more stacks) are squat structures, the structure height is the lesser dimension and equation 1 reduces to:

$$H_g = 2.5\ H \qquad (2)$$

The GEP stack height calculations for the HRSG and tail gas treatment incinerator stacks are summarized in Table 3-6. Use of the de minimis GEP stack height (65 meters) provides the maximum allowable GEP stack height for the two stack types of concern. Therefore, the GEP stack height for the HRSG and tail gas treatment incinerator stacks is 65 meters.

After the modeling analysis was completed, it was determined that the tail gas treatment incinerator stacks will actually have a nominal physical height of 22.9 meters which is less than the de minimis GEP stack height. Because the coal gasification plant tail gas treatment incinerator stack height will be less than GEP, a building downwash air quality modeling analysis for those stacks is required by EPA and FDER. A building downwash air quality modeling analysis was performed for the coal-derived gas 100% load 75°F ambient temperature fuel scenario assuming stack heights of 15.2 meters, 22.9 meters, and 45.7 meters for the tail gas treatment incinerator stacks and 65 meters for the HRSG stacks. The results of the building downwash modeling analysis indicated no violations of the PSD increments or ambient air quality standards. Furthermore, the air quality impacts for this modeling analysis

Table 3-6. Summary of GEP Stack Height Calculations for Proposed Source.

Stack Type	Constraining Structure	L[1] (m)	GEP Stack Height (m) (H_g = 2.5 H)
HRSG stacks	HRSG structure	17.4	43.5
	CG/CC plant control room structure	18.3	45.8
Tail gas treatment incinerator stacks	Coal gasification plant structure[2]	12.2	30.5
Deminimis GEP stack height	-----	----	65.0

[1] Because the applicable structure heights are less than the projected width, L = H.

[2] Envelope of coal gasification plant footprint.

Source: Ebasco, 1989.

were less than those for the No. 2 distillate fuel oil at 40°F ambient temperature emissions scenario. Hence, the worst-case air quality impact assessment for the proposed facility was based upon a GEP stack height credit assumption (65 meters).

4.0 CONTROL TECHNOLOGY REVIEW

4.1 INTRODUCTION

Background

Best Available Control Technology (BACT) represents an emissions limitation based upon the maximum degree of reduction achievable for regulated pollutants (and other regulated noncriteria pollutants of concern) determined on a case-by-case basis, taking into account energy, environmental, and economic impacts. The application of BACT cannot result in emissions of any pollutant that would exceed the level allowed by an applicable New Source Performance Standards (NSPS) (see Table 4-1). BACT is defined in the Clean Air Act in terms of a numerical emissions limit which can be based on the application of air pollution control equipment, specific production processes, methods, systems or techniques, fuel cleaning, or combustion techniques.

PSD regulations require major sources like the CG/CC Project to apply BACT for each regulated pollutant that may result in a significant emissions increase as defined by Florida Administrative Code (FAC) 17-2.310. Table 3-2 summarizes these significant emission thresholds by pollutant. Comparison of these rates with the estimated maximum air pollutant emissions from the project demonstrates that the project is subject to PSD/BACT review for sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulates (PM_{10} and TSP), carbon monoxide (CO), volatile organic compounds (VOC), lead (Pb), beryllium (Be), mercury (Hg), and inorganic arsenic (As).

Table 4-1. New Source Performance Standards

Combustion Turbines	
Pollutant	Standard
NO_x	$STD = 0.0075 \frac{14.4}{Y} + F$ Where STD = Allowable NO_x emissions (% allowable volume at 15% oxygen, dry basis) Y = Manufacturer's rated heat rate at rated load (Kilojoules/watt hour); Y is not to exceed 14.4 F = NO_x emission allowance for fuel bound nitrogen
SO_2	0.015% by volume (15% oxygen, dry basis), or
Sulfur in Fuel	≤0.8% by weight

Sulfur Removal/Recovery Systems

This performance standard prohibits discharges in excess of:

1) 0.025% by volume of sulfur dioxide at 0% oxygen on a dry basis if emissions are controlled by an oxidation control system or a reduction control system followed by incineration

2) 0.030% by volume of reduced sulfur compounds and 0.0010% by volume of hydrogen sulfide calculated as sulfur dioxide at 0% oxygen on a dry basis, if emissions are controlled by a reduction control system not followed by incineration.

Source: 40 CFR 60, Subpart J "Standards of Performance for Petroleum Refineries"*

Source: 40 CFR 60, Subpart GG, "Standards of Performance for Stationary Gas Turbines"

*Though standards for sulfur control from gasification-based power plants have not been established under NSPS, this Subpart J standard will be used as a guide for the gasifiers in BACT demonstration.

As the first step in the BACT analysis, available control technology alternatives are identified based on knowledge of the particular industry and previous control technology permitting decisions for other similar sources. These alternatives are evaluated to determine economic, environmental, and energy impacts and to assess the feasibility or appropriateness of each alternative as BACT based on site-specific factors. If a control alternative is not applicable, or if it is technically, economically, or environmentally infeasible, it is rejected as BACT, and excluded from further analysis. For the remaining applicable options, economic, energy, and environmental impacts and technical considerations are evaluated and compared. The BACT proposal should result in an emission limitation corresponding to the technically and economically feasible alternative that yields the best degree of control, considering the above factors.

Process Description

The term combined cycle refers to a power cycle with a CT, heat recovery steam generator (HRSG) and steam turbine (ST) combined in a sequential arrangement. The basic CT consists of a compressor, a combustor, and a turbine in series. The intake air is compressed and delivered to the combustor at substantially increased pressure and temperature. There, the fuel is burned and the temperature of the gases is increased. These high temperature, high pressure gases then expand through the turbine causing it to rotate. The turbine drives the electrical generator. The exhaust from the combustion turbine then flows directly through the HRSG. Steam produced in the HRSG is used to drive the ST's. Electrical generators, driven by CT's and ST's, produce the electrical power.

Coal gasification is based on a reaction of coal with steam and oxygen. The steam/coal reaction at high temperatures in a gasifier produces a mixture consisting mainly of carbon monoxide (CO) and hydrogen (H_2). The process requires heat to maintain reaction temperatures. The heat can be supplied indirectly through heat exchangers or by oxidizing part of the coal with air or oxygen in the gasifier. When gasified with steam and oxygen, coal produces a medium-Btu gas.

Fuels

The Martin CG/CC Project will initially maintain dual fuel capability, using natural gas as the primary fuel, with No. 2 fuel oil as backup fuel. Upon completion of the CG units, a low sulfur, medium-Btu gas derived from coal will be used. Natural gas or No. 2 fuel oil will then serve as backup fuel.

Natural Gas. Initially, natural gas supplied by pipeline will serve as the primary fuel for the CC unit portion of the CG/CC units. A typical fuel analysis for natural gas is presented in Table 2-10.

Fuel Oil. No. 2 fuel oil delivered by truck or exisiting pipeline to the Martin Site will serve as the backup fuel for the CC units. A typical fuel analysis is presented in Table 2-11.

Coal and Coal-Derived Gas. Since numerous coal supply sources will be considered to determine those which will be selected to supply the CG/CC units, a range of coal properties is presented in Table 2-12. The design coal has the following properties: 10,500 Btu/lb, 18 percent ash, 4.3 percent sulfur. The four CG units will use 19,000 tons of 10,500 Btu/lb coal per day at full load at 75° F. This results in the peak production and firing of approximately 1,000 million standard cubic feet/day of coal-derived gas in the eight CT's, collectively.

The design fuel analysis for the gas derived from gasification of the design coal is presented in Table 2-13.

Emission Sources

The primary source of air emissions will be the CT, firing natural gas, No. 2 oil, or coal-derived gas. There will be eight individual CT/HRSG stacks. The Martin CG/CC Project's secondary air emission sources will be as follows:

- Coal gasification plants (incinerator stacks)
- Oxygen plant vents
- Material handling systems
- Auxiliary boilers (two, one per 800 MW CT block)
- Emergency diesel generators (two, one per 800 MW CT block)
- Flare stacks (four, one per gasification plant)

Stack gas air emissions from CG units are associated with that residual portion of the coal-derived gas not directed for firing in the CTs, but rather sent to the tail gas treatment incinerator. CG unit operation and its related emissions occur only when the CTs are being fired with coal-derived gas. The supporting dry bulk material handling systems (coal, limestone, and slag) will be sources of fugitive dust.

The auxiliary boilers will operate only during start-up and shutdown and, therefore, will not operate concurrently with the

CTs under normal load operation. The emergency diesel generators will be used only for periods when in-plant power is lost. The emergency flare stacks will operate only during gasifier start-up/shutdowns and during infrequent, unanticipated interruptions of the CG units' operating cycles. Given the infrequent and/or emergency mode of operation of the auxiliary boilers, emergency flare stacks, and emergency diesel generators, emissions from these sources are not considered in the BACT analysis.

4.2 BEST AVAILABLE CONTROL TECHNOLOGY SUMMARY

The proposed control technologies and associated air pollutant emission limitations for the CC units, CG units, and material handling systems are summarized in Table 4-2.

Table 4-2 lists the proposed air emission controls by system for each of the applicable fuels. Note that tail gas incinerator emissions will occur only when coal-derived gas is fired in the CT's.

4.3 REVIEW OF PREVIOUS BACT DETERMINATIONS

The evaluation of BACT for the proposed CG/CC project involves an assessment and comparison of the proposed emissions control system and alternative systems which offer a greater degree of emissions control.

To initiate this process, recent supplements to the "USEPA BACT/Lowest Achievable Emissions Rate (LAER) Clearinghouse-Compilation of Technology Determinations" (EPA, 1988) were reviewed for large stationary combustion turbines (>70 MW), similar to those which will be utilized in the proposed

Table 4-2. Summary of Proposed BACT (Page 1 of 3)

Facility: Combined Cycle Power Plant

Pollutant	FUELS: Natural Gas	No. 2 Oil	Coal Derived Gas
NO_x	Combustor Design and Steam Injection (42 ppmvd)	Combustor Design and Steam Injection (65 ppmvd - with adjustments for fuel bound nitrogen, see 40 CFR Subpart GG)	Combustor Design and Steam Injection (42 ppmvd)
SO_2	Use of Low Sulfur Fuel (Sulfur Cont. = Trace)	Use of Low Sulfur Fuel (Sulfur Content <0.5%)	Use of Low Sulfur Fuel (Sulfur Content <0.8%)
CO	Efficient Combustion (50 ppmvd)	Efficient Combustion (50 ppmvd)	Efficient Combustion (50 ppmvd)
VOC	Efficient Combustion (1 ppmvd)	Efficient Combustion (6 ppmvd)	Efficient Combustion (9 ppmvd)
Particulates	Inlet Air Filters, Steam Injection, Efficient Combustion, Low Particulate Fuel	Inlet Air Filters, Steam Injection, Efficient Combustion, Low Particulate Fuel	Inlet Air Filter, Efficient Combustion, Low Particulate Fuel
Lead	N/A	N/A	Efficient Combustion
Beryllium	N/A	Efficient Combustion	Efficient Combustion
Mercury	Efficient Combustion	Efficient Combustion	Efficient Combustion
Inorganic Arsenic	N/A	Efficient Combustion	Efficient Combustion

Table 4-2. Summary of Proposed BACT (Page 2 of 3)

Facility: Coal Gasification Plant/Sulfur Removal and Recovery System

Raw Product Gas

Pollutant	Control Technology
Sulfur	Acid Gas Removal (95.1%)
NO_x	See combined cycle summary
CO	See combined cycle summary
VOC	See combined cycle summary
Particulates	Water scrubbing
Lead	See combined cycle summary
Beryllium	See combined cycle summary
Mercury	See combined cycle summary

CG Emissions (Tail Gas Treatment)

Pollutant	Control Technology
SO_2	Tail gas treatment (99.9% sulfur recovery, 250 ppm)
NO_x	Combustion controls
Lead	Efficient Operation
Mercury	Efficient Operation
Beryllium	Efficient Operation
Inorganic Arsenic	Efficient Operation

Table 4-2. Summary of Proposed BACT (Page 3 of 3)

Facility: Material Handling and Storage

Fugitive Dust Source	Control Technology
Coal Unloading	Enclosed with Dry Collection System
Limestone Unloading	Wet Suppression System[1]
Conveyors and Transfer Points (Coal, Limestone, Slag)	Enclosed with Dry Collection System
Coal Storage (Inactive)	Crusting Agent Application (60% Control)
Coal Storage (Active)	Surfactant Application[1]
Coal Storage (Active) and Reclaiming	Surfactant Application[1]
Limestone Storage	Crusting Agent Application[1]
Slag Transport to By-Product Storage Area	Paved Road Covered Conveyor (95% Control)
Slag By-Product Storage Area (Inactive)	Topsoil Covered and Seeded (100% Control)
Slag By-Product Storage Area (Active)	Compaction, Temporary Cover (Natural or Synthetic)
Sulfur Storage	Stored in molten state in tanks

N/A - Not applicable
[1]Undefined rate of fugitive dust control. No controls were assumed in fugitive dust impact analysis in Section 6.0.

Source: Bechtel, 1989

project. Additional BACT determination information was derived for combustion turbine and CG/CC projects not yet addressed in Clearinghouse compilations. These determinations are summarized in Table 4-3.

As shown in Table 4-3 the majority of recently permitted large combustion turbines and all of the coal-derived gas fired turbines utilize wet injection for NO_x control and proper combustion techniques for CO/VOC control. The recent BACT determinations in California and New England have included the use of SCR controls because of significant ozone and/or NO_x concerns (nonattainment classifications for these pollutants requiring application of LAER technology). The proposed project is located in attainment area for all criteria pollutants and therefore not limited to LAER.

The recent permitting of the Chesterfield Power Station combined cycle units provides the first and only approved BACT determination for an advanced gas turbine plant firing coal-derived gas, natural gas and No. 2 oil. Given its similarity to the proposed project, the Chesterfield BACT (steam injection NO_x controls, efficient combustion for CO and VOC, and use of low sulfur fuel for SO_2) provides an appropriate precedent to be used in the determination of BACT for the proposed project.

In Florida, the recent PSD permits and BACT determination for combustion turbines (all >70 MW) have required wet injection for NO_x control. The emission limits included in these permits were 42 ppm and 65 ppm (corrected to 15 percent O_2, dry conditions) respectively, for natural gas and fuel oil firing.

Table 4-3. Summary of Previous BACT Determination (Page 1 of 2)

Facility	NO_x Gas	NO_x Oil	VOC Gas	VOC Oil	CO Gas	CO Oil	SO_2 Gas	SO_2 Oil	Particulates Gas	Particulates Oil
Combustion Turbines										
Ocean State Power Burrillville, RI GE 7E, Combined Cycle	9 ppmvd (Selective Catalytic Reduction)	42 ppmvd	4.1 ppmvd (Efficient Combustion)	7.2 ppmvd	25 ppmvd (Efficient Combustion)	32 ppmvd	0.0027 lbs/mBtu	0.0027 lbs/mBtu	0.01 lb/mBtu	0.01 lb/mBtu
Basic American Foods King City, CA GE 7E, Combined Cycle	9 ppmv (Selective Catalytic Reduction)	47.8 pph	1.0 pph (Efficient Combustion)	1.0 pph	20 pph (Efficient Combustion)	22 pph	---	---	---	---
Gilroy Energy, Co. Gilroy, CA GE 7E, Combined Cycle	25 ppmvd (Steam Injection)	25 ppmvd	40 tpy (Efficient Combustion)	40 tpy	22.9 pph (Efficient Combustion)[1]	---	--- S in Fuel	0.12%	25 tpy	25 tpy
Hay Road, DP&L Edgemoor, DE KWU V84.2, Simple Cycle	42 ppmvd (Water Injection)	97 ppmvd	--- (Efficient Combustion)	2 ppmvd	15 ppmvd (Efficient Combustion)	15 ppmvd	---	56 ppmvd	---	0.2 pph
Midway-Sunset Cogeneration California GE 7E	85 pph (each) (Quiet Combustor, Water Injection)	140 pph (each)	---	---	94 pph (each) (Efficient Combustion)	94 pph (each)	---	---	---	---
Alaska Electrical Generation & Transmission Big Lake, AK 80 MW Turbine	75 ppmvd (Water Injection)	75 ppmvd	---	---	109 lb/scf Fuel (Efficient Combustion)	109 lb/scf Fuel	---	0.06% S in Fuel	10% Opacity	10% Opacity

[1]Retrofitting CO Catalyst Control Technology

Table 4-3. Summary of Previous BACT Determination (Page 2 of 2)

Facility	NO_x Gas	NO_x Oil	VOC Gas	VOC Oil	CO Gas	CO Oil	SO_2 Gas	SO_2 Oil	Particulates Gas	Particulates Oil
<u>Coal Gasification/Combined Cycle</u>										
Cool Water Coal Gasification Program Daggett GE 7E, Combined Cycle Texaco Gasification Process	140 lbs/hr (Steam Injection)	---	---	--- (Efficient Combustion)	100 ppm	--- (Selexol/ Claus/ SCOT)	175 pph	--- (Venturi Scrubbing)	10 pph	---
Chesterfield Power Station[2] Virginia Power Chesterfield, VA GE 7F, Combined	77 ppmvd[3] ppmvd[4] 77 (Steam Injection)	65 lb/mBtu ppmvd[5] (Proper Combustion)	0.0103 lb/mBtu	0.0103 (Efficient Combustion)	140 pph	140 pph lb/mBtu <0.3%	0.33 lb/mBtu <0.3% S in Fuel	0.33 lb/mBtu S in Fuel	0.011 lb/mBtu	0.011

[2]Chesterfield Power Station operates on coal derived gas provided by a remote coal gasification facility.

[3]Natural gas firing related NO_x limit 42 ppmvd.

[4]Firing No. 2 oil with <0.015% fuel bound nitrogen.

[5]Firing No. 2 oil with ≥0.015% fuel bound nitrogen.

4.4 CONTROL TECHNOLOGY ALTERNATIVES

The following sections evaluate the control technology alternatives for those pollutants emitted from the major sub-facilities of the CG/CC Project (CC units, CG units, oxygen plant, and bulk material handling facilities).

CC Units

Sulfur Dioxide (SO_2). The CC units will be capable of firing natural gas, No. 2 fuel oil, and coal-derived gas. As natural gas contains only trace amounts of sulfur, there are no viable control technology alternatives. The inherently low sulfur content in natural gas represents BACT for CC units when firing this fuel. However, since No. 2 fuel oil and coal-derived gas may contain more fuel-bound sulfur, SO_2 control technology alternatives when firing these fuels were evaluated.

Since the coal-derived gas SO_2 control technologies are an integral part of the coal gasification process, these alternatives are addressed with the CG unit controls. The SO_2 control alternatives for No. 2 oil in the CC units include flue gas desulfurization (FGD) and demonstration that No. 2 fuel oil represents a low sulfur fuel.

FGD. When fuel oil is fired in the CTs, the SO_2 emissions generated may exceed the "significant threshold" level, as defined in Table 3-2. The most stringent control technology from reducing SO_2 emissions resulting from firing of this fuel in CTs would be the use of an FGD system. However, high pressure drops across FGD systems make them infeasible for application on CTs.

Low Sulfur Fuel. The No. 2 fuel oil used by the CC units will be restricted to 0.5% sulfur or less by weight. The use of this fuel is generally considered to represent BACT for the CC units.

Proposed BACT for SO_2. Use of low sulfur fuel (trace in natural gas, less than 0.5 percent in No. 2 fuel oil, and less than 0.8 percent in coal-derived gas) represents BACT for SO_2 in the subject CC units. This low sulfur fuel use will ensure compliance with 40 CFR 60, Subpart GG, the applicable standards.

Nitrogen Oxides (NO_x). Alternative methods of NO_x control were identified based on a review of EPA's BACT/LAER information, the EPA New Source Review (NSR) database, recent permitting activity, and general knowledge of potential control technologies for the industry. The NO_x control techniques identified for evaluation include:

- o Selective catalytic reduction (SCR)
- o Wet injection (inclusive of moisturization of coal-derived gas)
- o Selective noncatalytic reduction (SNCR)
- o Low-nitrogen distillate oil
- o Dry combustion techniques

From this list SNCR, low nitrogen distillate oil and dry combustion techniques were quickly discounted, as shown below.

SNCR. There are no known applications to combustion turbines. Noncatalytic reduction, which is a flue gas treatment technique, is not feasible because it requires flue gas temperatures in the range of 1,300 to 2,100°F with an optimum temperature of 1600 to 1900°F. The proposed HRSG exhaust temperature is considerably lower than this required temperature range. The cost of additional fuel or similar energy supply needed to achieve exhaust temperatures compatible with SNCR operations makes this alternative inappropriate for further evaluation.

Low Nitrogen Content. Combustion of low-nitrogen fuel oil also has no known application on CTs and is considered infeasible because low nitrogen distillate oil is not reliably available in southern Florida. Nitrogen content is not a refinery specification for distillate oil which can be controlled during the refining process. The NSPS for combustion turbines recognizes this fact, and includes an emissions limitation adjustment to account for fuel-bound nitrogen variability. Therefore, low-nitrogen fuel is also judged to be inappropriate for further evaluation.

Dry Combustion Techniques. The following combustion modifications are available to reduce NO_x without water or steam injection:

- 2-stage combustion with the first stage being fuel rich and the second stage being fuel lean, and

- Premixing of the fuel and the combustion air with a large excess air coefficient.

Of these methods, premixing has the greatest potential for NO_x reduction, since the maximum flame temperatures that occur can be lowered significantly.

Dry combustion NO_x controls are only effective when firing natural gas. The dry combustors can be operated with liquid fuels together with wet injection for NO_x reduction in the conventional way.

Kraftwerk Union-Utility Power Corporation (KWU-UPC) utilizes dry combustion controls (premixing) for NO_x control when firing natural gas in their conventional combustion turbines. KWU-UPC does not offer "advanced" versions of combustion turbines which utilize this dry control technology.

The remaining potentially feasible NO_x control techniques for the combined cycle units, SCR and wet injection, are discussed below.

Selective Catalytic Reduction and Wet Injection. A brief discussion of nitrogen oxides (NO_x) formation mechanisms and their relationship to the NO_x control techniques is presented below to provide perspective on the SCR and steam control techniques discussed later.

NO_x compounds consist of nitrogen and oxygen and are products of all normal combustion processes. Nitric oxide (NO) is the predominant form of NO_x produced during combustion. Almost all of the NO is subsequently oxidized to form nitrogen dioxide (NO_2) in the atmosphere.

NO_x emissions are generated in fuel combustion by two separate sources. NO_x is formed by the reduction and subsequent oxidation of the available organically bound nitrogen in the fuel (fuel NO_x). NO_x formation also results from high temperature oxidation of atmospheric nitrogen which enters into the combustion process as part of the combustion air (thermal NO_x).

Although the precise mechanism by which fuel and combustion air nitrogen are converted to NO_x is not completely understood, the relative quantities of fuel NO_x and thermal NO_x are known to be a function of combustor design factors, fuel composition and plant operating parameters.

The basic parameters that affect thermal NO_x emissions are peak flame temperature, residence time at flame temperature, pressure and the mole fractions of nitrogen and oxygen at the start of the NO_x generation processes.

The following reactions represent the formation of thermal NO_x which is formed by thermal energy acting on nitrogen and oxygen components found in air:

$$O + N_2 = NO + N$$

$$N + O_2 = NO + O$$

$$N + 2OH = NO_2 + 2H$$

NO_x concentration increases with increasing temperature in the combustion chamber which, in turn, increases with increased combustor-inlet temperature and increased fuel to air ratio. For the typical combustion turbine, NO_x emissions increase with load. As a corollary, decreased loads reduce NO_x emissions.

As with other fuels, combustion of coal-derived gas in the combustion turbines produces NO_x. Most coal-derived gases contain little or no fuel-bound nitrogen so only thermal NO_x is formed. Because coal-derived gases have higher adiabatic flame temperatures than do natural gas and fuel oil, they produce relatively more thermal NO_x.

Selective Catalytic Reduction. SCR is a post-combustion NO_x reduction technique while wet injection is a combustion control approach. SCR is used in conjunction with wet injection to achieve more stringent NO_x control levels than can be achieved with wet injection alone. Given this additional measure of NO_x control, SCR is considered the most effective control technology in the evaluation which follows below.

Control Technology. In SCR technology, ammonia is used as a reducing agent in the presence of oxygen over a V_2O_5 (vanadium pentoxide) bed or a bed of other catalysts. The general chemical reaction is given below:

$$4NO + 4NH_3 + O_2 = 4N_2 + 6H_2O$$

The reaction has a relatively narrow flue gas temperature "window." Below 650°F the reaction slows down, while above 800°F the catalyst is progressively destroyed and NH_3 may be oxidized to NO_x. Typically the catalyst is located in the heat recovery steam generator (HRSG) of a combined cycle unit having the optimum temperature range (650-800°F) during full load operation.

The SCR catalyst also produces some SO_3 from sulfur present in the fuel. A side reaction with ammonia also produces ammonium sulfate and bisulfate, when firing fuels that contain sulfur. These by-products can form highly corrosive deposits on downstream surfaces, greatly reducing equipment life. The operating conditions under which these deposits can form have not yet been fully defined.

Another concern with the use of SCR is the amount of ammonia slip that occurs, i.e., the portion of NH_3 introduced into the gas stream that passes through the catalyst unreacted. Some regulatory agencies have been requiring that NH_3 slip be limited to low levels, on the order of 5-10 ppm. The lower the slip allowed the greater the amount of catalyst required. The least perceptible odor concentration of ammonia is 5 ppm. Levels of 50 to 100 ppm cause only minor discomfort with no impairment from prolonged exposure. SCR vendors generally design the catalyst bed to limit unreacted NH_3 in the stack to between 10 and 15 ppm.

For applications utilizing sulfur-containing fuels (No. 2 oil, coal-derived gas), the use of SCR presents several potential problems. Catalyst systems have been shown to promote oxidation of sulfur dioxide (SO_2) to sulfur trioxide (SO_3) which subsequently combines with water to form corrosive sulfuric acid. Additionally, the side reaction between sulfur-containing species and ammonia results in the formation of sticky and corrosive ammonium bisulfate. Furthermore, the presence of sulfur oxides can deactivate some SCR NO_x catalysts. Under SO_x rich environments, it is necessary for the SCR catalyst to exhibit both high resistance to SO_x poisoning and a low oxidation activity for the SO_2 to SO_3 conversion. Thus, SCR used in conjunction with sulfur-containing fuels can potentially promote operational, corrosion and safety problems.

<u>Operating Experience with SCR</u>. In the United States only a limited number of installations have been equipped with SCR. One installation has been in operation with some small Japanese (1.2 MW) gas turbines since March 1985. These units have been fired with California crude oil and the results are not yet conclusive as to NOx removal capacity. Flue gas distribution, mixing, and ammonia metering remain problematic, since local concentrations of NO_x and ammonia must be closely matched.

Union Cogeneration of California has had relatively poor experience with SCR. On-line since late 1986, the three small natural gas-fired turbines (16 MW each) have not achieved design specifications of 25 ppmv NO_x.

Two other California installations have been in operation since 1986. The first has been in operation since January 1986 on a General Electric aero-derivative LM2500 gas turbine (20 MW) in a United Airlines (UAL) cogeneration facility in the Bay Area. The turbine has been operated at part load on a liquid "jet fuel." The flue gas temperature was higher than that allowable for the SCR catalyst as a result of the part load operation and the use of jet fuel (with its much higher firing temperature), and the catalyst failed. The UAL catalyst failure illustrates the sensitivity of SCR catalyst to fuel and operating temperature. Furthermore, in the UAL case there was an unexpected side reaction. The chromium in a stainless steel liner inside the HRSG acted as a catalyst for the NH_3-O_2 reaction to form additional NO_x.. Thus, while the SCR catalyst was reducing NO_x, additional NO_x was being formed by the chromium catalyzed reaction with ammonia and oxygen. Although other materials may be used for HRSG internals, this unexpected result illustrates that the SCR technology has not developed a sufficient data base to be considered "proven."

The second application is an LM2500 Unit (25 MW) at the Willamette Cogeneration facility in Ventura County that went on line in April 1986. That unit operates only on natural gas and appears to be operating in a satisfactory manner. This illustrates that SCR can work in the right application, i.e., base loaded, to assure that catalyst temperature is as predicated, and with a clean fuel.

As can be seen, long-term operational data on the application of SCR to large (>75 MW) gas turbines in the United States does not exist. Moreover, there is no long-term operating experience for turbines that fire oil or coal-derived gas. These factors plus the disadvantages of SCR, which include the necessity for good temperature control, the expense of ammonia, the potential for catalyst contamination by trace/heavy metals and SO_x in the flue gas when burning fuel oil, plugging of the catalyst pores by dust, and ammonia slip, may make SCR unsuitable for the proposed project.

Steam Injection. Given the availability of steam from the proposed combined cycle units and the similar NO_x control ability of steam and water injection, steam injection serves as the wet injection technology for this project. Steam also has two advantages over water injection; less mass is required for optimum control of NO_x and no particulate matter emissions increase will occur.

Control Technology. Steam can be introduced into the primary combustion zone by premixing with the fuel prior to injection into the combustion zone, by injection into the primary air stream, or by direct injection into the primary combustion zone. The effectiveness of each method is strongly dependent on the primary zone residence time and fuel being utilized.

Although NO_x reduction by steam injection is quite effective, there are several operational concerns, including:

- Requirements for high-pressure steam
- Hardware requirements which increase plant size and complexity
- Dynamic pressure pulsations (produced from steam injection) reduce equipment life

- o Steam delivery system hardware which results in increased failure potential and overhaul/maintenance time

- o Uncertainty regarding long-term effects on turbine components

When increasing amounts of steam are added to the combustor, a point is reached at which a sharp increase in carbon monoxide (CO) emissions occurs. This is defined as the point of maximum moisturization. As well as being an undesired pollutant, CO indicates incomplete combustion. Steam injected above maximum moisturization severely reduces combustion efficiency, increases VOC emissions, risks smoke production and even complete loss of flame.

Operating Experience. NO_x control by steam injection has been reported in a relatively large number of cases since 1978. In most cases, however, operating experience dates back only to 1984-85 and this experience is based primarily on firing natural gas.

Typically, when firing natural gas, steam injection at a rate of 1.5 pounds, or water injection at 0.8 pounds per pound of fuel, can bring the NO_x concentration from the 150 ppm level down to approximately the 42 ppm level. NO_x levels can be further reduced by increased steam or water injection, but at the expense of higher CO and VOC emissions. If, the steam injection rate could be doubled to 3 lb/lb, the NO_x concentration could theoretically be reduced to 10-15 ppmv, but the CO and VOC levels would increase to environmentally unacceptable levels (CO to about 1000 ppmv and VOC to about 200 ppmv). Thus, the degree of steam injection is a balance between meeting the required NO_x emission level, and achieving acceptable CO and VOC levels.

Steam injection is less complicated than water injection since only mixing is required. Water injection requires atomization of exceptionally high purity water to be effective and to avoid turbine blade erosion.

When firing fuel oil and coal-derived gas, control of NO_x with steam injection is more difficult due to higher flame temperatures and associated higher thermal NO_x production.

Both the Cool Water and the Dow coal gasification/combined cycle demonstration projects have successfully proven steam injection techniques. As these projects use conventional combustion turbines, the degree of NO_x control for higher temperature advanced combustion turbines has yet to be tested.

Impact Analysis for NO_x Control Options. NO_x control alternatives and emission limits were selected for evaluation in quantifying economic, environmental and energy impacts. The 42 ppm level is achievable by steam injection and the 9 ppm are hypothetically achievable through a combination of steam injection and SCR.

The project as discussed earlier may also fire No. 2 fuel oil (as backup fuel) and coal-derived gas pending installation of the gasification plants. Natural gas was selected as the fuel for BACT impact evaluation because it represents the initial primary fuel, and because very little information is available on predicting NO_x emissions using coal derived gas, the degree of NO_x control achievable and the costs associated with such controls. The environmental impacts of oil firing will be discussed because of its unique constraints on SCR operation.

NO_x emission limits based on the selected BACT NO_x control strategy will be identified for natural gas, coal-derived gas and No. 2 oil applications.

Environmental Impacts. The environmental impacts associated with the application of SCR include ammonia handling, storage, and emissions, generation of ammonia bisulfate, chloride salts formation and disposal of potentially hazardous spent catalyst.

Vanadium pentoxide, which is potentially one of the active ingredients in the SCR catalyst, is listed as a hazardous chemical waste under RCRA 40 CFR 261.30. Disposal of this SCR-related waste poses an additional economic and environmental burden which must be factored into the BACT decision process.

The environmental impacts associated with application of steam injection include increased VOC and CO emissions with steam addition past the point of maximum moisturization, increased water use and generation of water treatment related wastes.

Economic Impacts. The total annualized cost for the alternative NO_x control technologies is approximately $36.5 million. The cost effectiveness for SCR relative to the proposed level of control was estimated to be about $6,976 per ton of NO_x removed for natural gas firing. See Table 4-4 for a summary breakdown of these costs.

Energy Impacts. Steam injection to 42 ppmv from the baseline level requires approximately 1.4 MBtu/year of additional fuel input. The fuel is needed to offset increased energy demands with steam injection including the electrical requirements for the demineralizer equipment and transfer pumps and the heat requirement for generating additional steam for injection into the system. Applying steam injection combined with SCR to the next control level of 9 ppm requires additional Btu's/yr due to back pressure effects and to the electrical requirements for ammonia vaporization. The energy impacts (expressed in Btu's) were based on the cost estimates for the respective energy impact components referred to above.

Proposed BACT for NO_x. The SCR technology is rejected as BACT, and combustor design/steam injection is proposed as BACT. The NO_x emission limits at 15 percent O_2 as follows:

Fuel	Emission Rate (ppmv)
Natural gas	42
Coal-derived gas	42
No. 2 oil (with adjustments for fuel-bound N)	65

The rationale for this BACT determination is as follows:

- o SCR is not demonstrated and may be technically infeasible with coal-derived gas or oil-fired combined cycle units due to operating difficulties and catalyst poisoning from sulfur compounds.
- o SCR has not previously been applied to coal gasification/combined cycle units.
- o The incremental cost effectiveness of SCR over steam injection alone is about $6,976 per ton of additional NO_x removed.

- o Application of SCR will result in negative environmental impacts due to emissions of NH_3 and ammonium bisulfates, generation of hazardous waste in the form of spent vanadium catalyst.

- o Steam injection of an advanced GE combustion turbine has been applied as BACT previously (Virginia Power Chesterfield (CG/CC)).

Particulates. Steam injection (versus water), inlet air filtering, clean combustion, and regular CT inspection and maintenance are BACT for both the natural gas- and No. 2 fuel oil-fired cases. Because the fuel gas fired in the CTs will be essentially free of particulates, emissions of particulates from the combined cycle are extremely low. Post-combustion controls that could further reduce emissions, such as electrostatic precipitators (ESPs), baghouses, and wet scrubbers are not feasible because of either the high pressure drops across these control devices or the low collection efficiencies encountered when firing oil or gaseous fuels. These post-combustion controls have not been used with CC units and were not considered further.

Therefore, the most effective control strategy, inlet air filtering, clean combustion, and steam injection (versus water injection) will be used.

Carbon Monoxide (CO). Alternative CO control technologies include:

- o External controls
- o Efficient combustion

External Controls (Oxidation Catalyst). With an oxidation catalyst (OC), CO is oxidized to CO_2 in the presence of a platinum-rhodium catalyst. The main reaction is:

$$CO + 1/2\ O_2 = CO_2$$

This reaction can occur in the temperature range of 600 to 1,000 °F. Therefore, the CO can be located at the gas turbine exhaust or in the same temperature zone as an SCR unit. CO conversion efficiencies over 90 percent have been demonstrated under optimum conditions.

Catalytic oxidation is used to control CO emissions from small gasoline engines, but it has only recently been applied to CTs. In 1982 Johnson Matthey installed a catalytic converter for CO emissions control on two smaller combustion turbines (35 MW). This installation reduces CO from 100-200 ppm to levels below 13 ppm. The Gilroy Energy Project (a 120 MW cogeneration CC unit in California) expects to add CO in the near future.

CO was rejected as a control device because the advanced combustion turbine CO emissions are normally at a low level and additional controls are not cost effective. The estimated costs per ton of CO removed exceed $14,000 (FPL Lauderdale Combined Cycle application to FDER). No costs are associated with combustion techniques since they are inherent to the process.

Efficient Combustion. CO emissions are an indicator of incomplete combustion. By efficient operation of the combustors, CO emissions can be minimized. The emissions of NO_x and CO are inversely related. As NO_x emissions decrease, CO emissions increase. Therefore, an optimum balance must be established between CO and NO_x emissions.

Proposed BACT For CO. Due to the relative lack of CO operating experience for CC units and the inherent low CO concentrations from CTs, efficient operation of combustors represents BACT. As emissions of CO and NO_x are inversely related, a balance must be established between NO_x and CO emissions. At the NO_x control steam injection rates needed to limit NO_x to 42 ppm, the CO emission rates are approximately 50 ppm.

Volatile Organic Compounds (VOC). Alternative VOC control technologies include:

- o External controls
- o Efficient combustion

External Controls. The catalytic oxidation control technology for VOCs is similar to that described for control of CO emissions. Since hydrocarbons are more difficult to oxidize than CO, a catalyst designed for 80 percent reduction of CO may reduce VOCs by only 20 percent.

Efficient Combustion. VOC emissions are an indicator of incomplete combustion. Efficient design/operation of combustors can effectively minimize VOC emissions.

Proposed BACT for VOC. VOC catalytic control technology does not represent commercially demonstrated technology; therefore, it does not warrant serious consideration against internal controls. Consequently, efficient design/operation of combustors that limit VOC emissions to 1 ppmv (natural gas firing), 6 ppmv (oil firing), and 9 ppmv (coal-derived gas firing) represents BACT.

Lead, Beryllium, Mercury, Arsenic and Nonregulated Pollutants. The only viable technology for controlling CT emissions of beryllium, lead, mercury, and arsenic emissions and nonregulated pollutants is efficient design/operation of the combustor. By minimizing the amount of fuel fired for each unit of power produced, efficient operation minimized the emissions of these fuel-bound trace constituents. No other technologies have ever been applied to CTs for controlling these emissions.

Coal Gasification Units

Through use of the coal gasification and plant BACT processes, the project will convert bituminous coal to a clean medium-Btu fuel gas for electricity production in the combined cycle plant. The gasification and air quality control processes are moderate temperature, moderate pressure, closed system operations.

When the combined cycle plant is converted to operate on coal-derived gas from the gasification plant, the emission control strategy emphasis is shifted to controlling chemical species in the fuel gas prior to combustion. The type of chemical species, the amount of each, and the method of cleanup depend on the gasification process and the applicable emission limits.

Processes to clean up the fuel gas prior to combustion can be categorized either as cold gas or hot gas cleanup processes. For cold gas processes, cleanup occurs below temperatures of 300°F. At these lower temperatures, conventional proven processes can be used that have been developed in other industries such as refining and gas processing. Use of these processes, however, requires cooling the hot gasifier gases. This not only inhibits plant performance, but it also requires expensive heat exchangers and increases plant complexity. Hot gas cleanup processes, on the other hand, treat the gas at or near gasifier temperatures. Cycle performance improves and capital costs decrease. However, these (hot gas cleanup) processes are not yet fully proven and will require concentrated developmental effort before their commercial viability dictates their consideration in the BACT selection process. Thus further evaluation of related control technologies focuses on cold gas cleanup processes.

Sulfur Dioxide (SO_2). Sulfur removal and recovery are integral parts of CG units and contribute to the inherent advantages of CG/CC over other coal-based electric generation technologies. Direct coal combustion requires removal of sulfur as SO_2 in a very dilute flue gas stream at low pressure. The costs are high and the removal efficiency is typically lower than for pre-combustion controls. Recovery of the sulfur in a useful form from SO_2 is even more expensive, complex, and requires processes with relatively limited commercial experience. The CG units, however, involve the removal of sulfur, principally as hydrogen sulfide (H_2S), plus some carboxyl sulfide (COS) from the high pressure, medium-Btu fuel gas produced in the CG units. The H_2S is converted to saleable elemental sulfur. This removal and recovery are less costly and can be extremely efficient.

Sulfur removal and recovery in CG units usually involve three processes:

- Acid gas removal (AGR)
- Sulfur recovery
- Tail gas treating

Acid gas is a name commonly used for gases containing CO_2, H_2S, and COS. These compounds can readily be removed from raw coal gas by many solvent absorption processes. For CG/CC applications, use of acid gas removal processes that selectively remove more H_2S than CO_2 are desirable. The use of such processes reduces the cost of both the acid gas removal and sulfur recovery by increasing the H_2S to CO_2 ratio in the recovered acid gas. Furthermore, the CO_2 left in the coal-derived gas improves the power output of the CTs.

Sulfur recovery involves converting the H_2S into elemental sulfur by the following reactions:

$H_2S + 3/2\ O_2 = H_2O + SO_2$ (partial oxidation of H_2S to SO_2)

$2H_2S + SO_2 = 2H_2O + 3/2\ S_2$ (conversion to elemental sulfur of the remaining H_2S)

This is most often accomplished by using the classic Claus process. The first oxidation reaction is fast and takes place in a high temperature furnace type reactor. The second reaction is relatively slow and requires several stages of catalytic reactors. The gas is cooled to condense and remove sulfur and is then reheated between reactors. Sulfur recovery in a Claus plant is usually in excess of 90 percent.

Tail gas treating processes are designed to recover the small amount of sulfur not recovered by the Claus plant. The high efficiency processes involve catalytic hydrogenation of all the sulfur compounds to H_2S leaving the Claus unit tail gas. Then H_2S is converted to sulfur by wet oxidation (such as the Beavon/Stratford process) or by recycling of the H_2S back to the Claus plant following solvent absorption as in the Shell

Claus Off-Gas Treatment (SCOT) process. The remaining tail gas is incinerated.

The two gasification combined cycle plants built in the U.S. use different combinations of these processes. The Cool Water plant uses all three (acid gas removal, sulfur recovery, and tail gas treating), while the Dow plant in Louisiana employs only acid gas removal and sulfur recovery to achieve a high degree of sulfur emissions control.

The application of sulfur removal (AGR) and recovery (Claus/Tail Gas Treatment) represents the "best" control technology for SO_2 control for coal gasification processes.

The specific AGR and Claus/Tail Gas Treatment technologies available for application to the project do not provide significantly different sulfur removal efficiencies or offer unique economic or technical advantages. Consequently, the determination of BACT for CG-related sulfur emissions focuses on the determination of overall sulfur compound removal efficiency from this strategy.

Acid Gas Removal. AGR systems each introduce a sulfur absorbing (chemical or physical) solvent to the raw-coal-derived gas stream. The nonhazardous solvents under consideration (Selexol, Rectisol, and Amines) all provide greater than 90 percent removal rates of sulfur in the raw-coal-product gas; therefore, the selection of the specific solvent for application will be based on operability during the detailed design of the CG units.

Sulfur Recovery. The options for sulfur recovery systems, in contrast to AGR systems, are limited. Claus sulfur recovery units and related processes which employ the Claus process chemistry dominate the sulfur recovery market.

This dominance, and the technology's reliability, overall environmental acceptability, and compatibility with the Martin CG/CC Project process requirements, rule out viable alternatives to using the Claus technology for sulfur recovery.

Tail Gas Treating. With the emergence of requirements for increased sulfur recovery in process plants, the treatment of tail gas from sulfur recovery units has, in some cases, become mandatory.

In the refining and gas processing industry the SCOT tail gas cleanup process is the leader regarding the number of tail gas treatment units installed, ease of operation, process availability, and general acceptance.

Additional SCOT-based tail gas treating process advantages are as follows:

- Developed specifically to mitigate Claus offgases
- When combined with an effective AGR system and Claus sulfur recovery system, nearly complete sulfur recovery can be achieved
- Can treat sulfur bearing compounds other than H_2S
- Does not produce undesirable side reactions

Though some other tail gas treatment processes may share some of these advantages, those processes are generally less commercialized and more expensive or they have been plagued by production of poor quality sulfur and by tower plugging problems.

Further evaluation of the "no treatment option" is not required since the most stringent control technology, SCOT tail gas treatment, will be used.

Proposed BACT for Sulfur Removal and Recovery. The recent gasification demonstration facilities have maintained at best a 95 percent overall sulfur removal efficiency during their operation. The CG/CC project expects to equal this level of performance.

Thus, the proposed BACT for sulfur removal and recovery is an AGR system followed by a Claus sulfur recovery plant and SCOT tail gas treating. The overall resulting sulfur removal rate is 95 percent.

Nitrogen Oxides (NO_x). Incineration of tail gas following tail gas treatment to convert the remaining H_2S to SO_2 results in the formation of NO_x, primarily from high temperature oxidation of atmospheric nitrogen which enters the combustion process as part of the combustion air (thermal NO_x). Consequently combustion temperature controls of thermal NO_x generated by the tail gas incinerator represent BACT for the CG units. These incinerator NO_x emissions are small relative to emissions from the combined cycle plants.

CO and VOC. Incineration of tail gas results in insignificant emissions of CO and VOC.

Particulates. In CG units, particulates removal is needed both for emission control and to protect processing equipment and operating efficiency.

Water scrubbing is generally used to clean the gas of particulates and to cool the gas prior to the sulfur removal step. The water scrubbing particulate control system represents BACT for the CG units.

Lead, Mercury, Beryllium, Arsenic and Nonregulated Pollutants. The only viable technology for controlling coal gasification plant emissions of lead, beryllium, mercury, inorganic arsenic and nonregulated pollutant emissions is efficient design and operation of the gasification process. CG/CC is considered a clean coal technology, potentially more efficient than other methods of combusting coal for power generation.

Oxygen Plant. The nitrogen vent from the oxygen plant is not a significant emitter of any criteria or non-criteria pollutants. There are no applicable federal NSPS standards for elemental nitrogen emissions. Application of BACT to the oxygen plants' nitrogen stream is not required.

Oxygen is produced by first filtering ambient air (to remove particulates), compressing, cooling, and, finally, distilling the air under pressure. By this process, oxygen is separated from the nitrogen and minor air constituents. Some of the nitrogen may be used for energy recovery, for various uses in the CG units, and as instrument gas. The remainder is vented to the atmosphere.

The stream discharged is of the same composition as that in the air intake, minus the oxygen and particulates removed in the filtering process. Thus, the nitrogen vent does not add any pollutants and, in fact, discharges a stream cleaner than the surrounding ambient atmosphere.

Bulk Material Handling. Fugitive particulate emission may result from storage and handling of coal, limestone, slag, and sulfur. Sources of fugitive particulate emissions from these activities can be divided into the following categories:

- o Coal and limestone delivery and unloading
- o Conveyors and transfer points for coal, limestone and by-products (slag)
- o Coal reclamation, crushing, and distribution to silos and CG units
- o Coal, limestone, slag, and fly slag storage

The following engineering design and operating practices have been incorporated in the material handling system design to minimize emission of fugitive dust:

- o Minimize number of material transfer points
- o Apply crusting agent application to inactive storage areas
- o Enclose conveyors and transfer points
- o Provide induced collection systems for dust

- Provide wet suppression systems (surfactant)
- Cover by-product storage areas (upon completion of cell)
- Handle and store sulfur in a molten or continuous crystalline state.

Though it is anticipated that these control features will effectively minimize fugitive dust emissions, credit for specific dust removal efficiency rates is taken only for inactive coal storage (crusting agent - 60 %), slag storage (compaction, temporary covers - 90%), slag transport (paved haul roads, covered conveyors with wind skirts - 95%) The emission rates for the other fugitive dust emission sources are developed using EPA emission factors and are listed in Section 6.0.

5.0 AMBIENT AIR QUALITY MONITORING DATA ANALYSIS

5.1 PSD Preconstruction Monitoring Applicability

The guidance in U.S. EPA (1987c) was used to determine acceptable monitoring locations, parameters to be monitored, and monitoring methods.

Based on the worst-case proposed source emissions data and preliminary air quality modeling results for the existing and proposed sources, it was determined that the following parameters be monitored for the following reasons:

- O_3 (VOC emissions were estimated to exceed 100 tons/year);
- SO_2 (Predicted impacts based on preliminary modeling were above the significant monitoring concentrations [13 $\mu g/m^3$, 24-hr average]);
- PM_{10} (Existing source TSP impacts based on preliminary modeling were close to the significant monitoring concentrations [10 $\mu g/m^3$, 24-hr average]);
- NO_2 (Predicted impacts based on preliminary modeling were close to the significant monitoring concentration [14 $\mu g/m^3$, annual average]);
- Wind Speed;
- Wind Direction;
- Ambient Temperature;

- o Sigma Theta (for stability); and

- o Relative Humidity.

A visit to the Martin Site was made to select air quality/meteorological monitoring site locations based on the results of the preliminary air quality modeling assessment. Based on the results of the site visit, Western and Eastern monitoring site locations were selected which satisfied EPA siting criteria for each parameter to be monitored, as well as security, telephone service, and power availability needs. The monitoring site locations are shown in Figure 5-1. Standard EPA monitoring methods and approved equipment were used at each monitoring site. Details are provided in Appendix 10.5.6.9.

Sulfur dioxide, ozone, nitrogen dioxide and particulate matter (PM_{10}) were measured at the West and East sites. Wind speed, wind direction, sigma theta (an atmospheric stability parameter), ambient temperature and relative humidity were also measured at the East site.

On-site monitoring data collection began officially on October 1, 1988 and continued for one full year and was coordinated with other FPL and FDER monitoring programs. FDER formally approved the use of six months of air quality and meteorological monitoring data in the SCA on August 28, 1989 (Rogers, 1989f).

5.2 <u>Existing Representative Air Quality Monitoring Data</u>

<u>Historical FPL Martin Site Air Quality Monitoring Network</u>. Background sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and total suspended particulates (TSP) have been collected by FPL at four sites (Nos. 1, 2, 3 and 4) in the vicinity of the

Martin Plant on a once every sixth day basis since October, 1973. These data were supplemented in 1979-1980 with two sites (Nos. 5 and 6) monitoring SO_2 and NO_2 with continuous analyzers and a seventh site (No. 7) monitoring TSP. Only about one year of continuous SO_2 and NO_2 monitoring data exists at Site Nos. 5 and 6. The other once every sixth day monitoring sites continue to operate with bubbler type samplers for SO_2 and NO_2 and standard high volume samplers for particulate matter. Figure 5-2 shows the location of the existing FPL air quality monitoring sites.

The existing FPL air quality monitoring data for the Martin Site indicate good background air quality (i.e., low concentrations) as shown in Table 5-1. Appendix 10.5.6.3 and Table 5-1 present a summary of the available SO_2, NO_2 and TSP monitoring data collected at all of the existing FPL sites for the years 1973-1988.

Florida DER Air Quality Monitoring Network. The area within a 50 km radius of the Martin Site (e.g., Martin, Palm Beach, Hendry, Glades, Highlands, Okeechobee, and St. Lucie counties) has FDER ambient air quality monitoring coverage for particulate matter only. The exception is Palm Beach County where ambient air quality data are also collected for carbon monoxide (CO), ozone (O_3), NO_2, and SO_2. The available FDER air quality monitoring sites located within this area are listed in Table 5-2 and shown in Figure 5-3. A summary of the FDER air quality monitoring data collected at those sites is presented in Table 5-3.

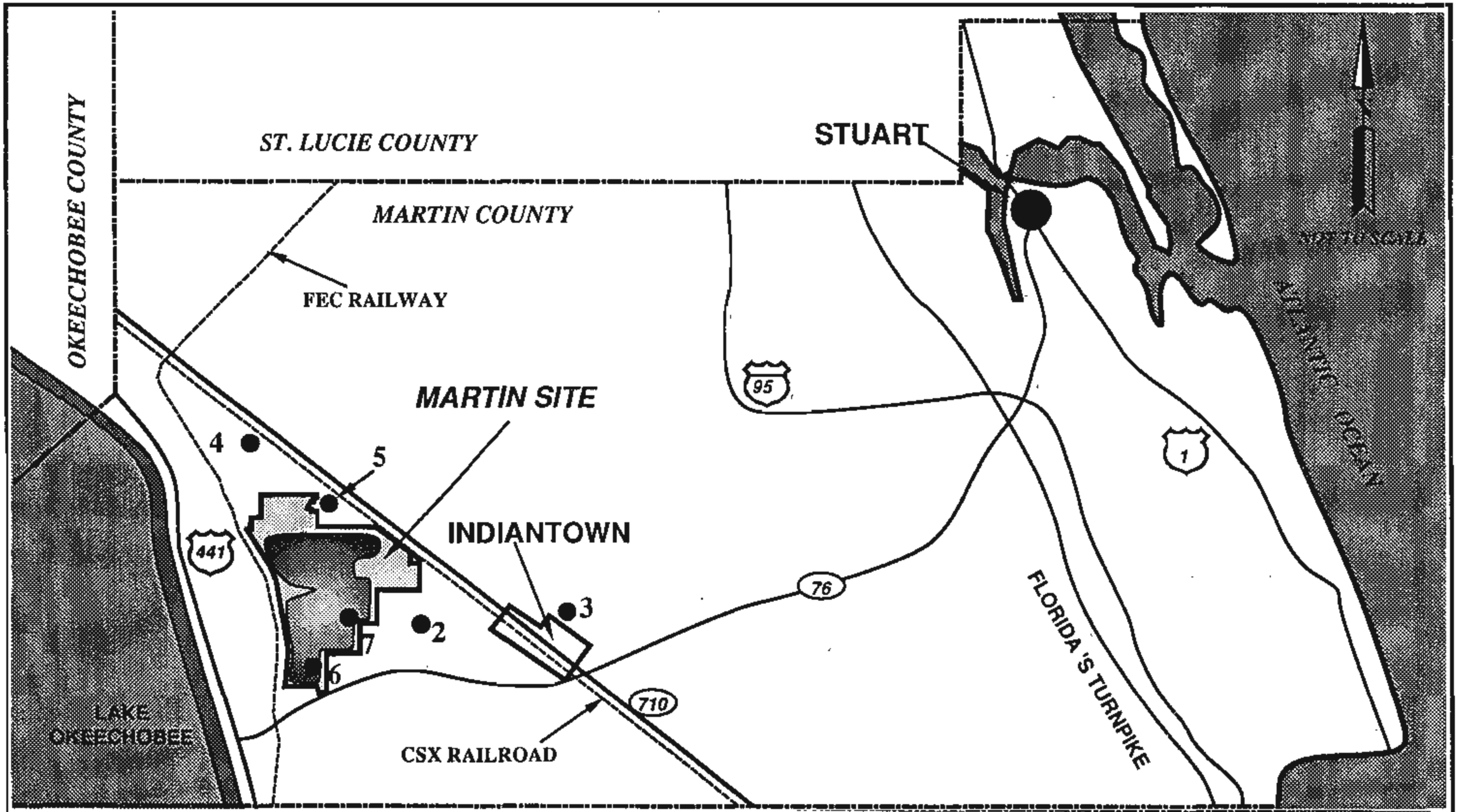


Figure 5-2
FPL AIR QUALITY MONITORING SITES

Source: FPL, 1980a

Martin CG/CC Project

FPL

Table 5-1. Summary of FPL Existing Ambient Air Quality Monitoring Data for the Martin Site Vicinity for the Period 1973-1988

Pollutant	Averaging Period	Station Number	Highest Concentration (ug/m^3)	EPA Standard (ug/m^3)	Florida Standard (ug/m^3)
SO_2	3-hr	5	105	1300	1300
	24-hr	5	61	365	260
	Annual	6	8	80	60
NO_2	24-hr	1	158	-	-
	Annual	5	16	100	100
TSP	24-hr	3	200(c)	260(a)	150
	Annual	-	(Not Available)	75(b)	60

(a) EPA Secondary Standard is 150 ug/m^3.

(b) EPA Secondary Standard is 60 ug/m^3.

(c) The TSP monitoring data for the existing FPL network for the period 1973-1988 appended in Section 10.5.6.3 contains two exceedances (1975, 180 ug/m^3 and 1986, 200 ug/m^3; both at site No. 3) of the FAAQS. These exceedances are considered isolated incidents uncharacteristic of the overall TSP monitoring data record for the Martin Site.

Sources: Envirosphere Company, 1988.
FPL, 1980.
FPL, 1980a.

Table 5-2. FDER Air Quality Monitoring Site Listing for Martin Site Vicinity

County	Area	Site I.D.	UTM Coordinates (km) East	UTM Coordinates (km) North	Monitored Parameters TSP	SO_2	NO_2	CO	O_3
Palm Beach	3420	017 J02	535.90	2947.40		X			
	3840	003 G02	592.48	2962.35		X			
	3840	004 G02	592.35	2916.80		X			
	4760	004 G01	589.00	2953.00	X		X	X	
	3420	006 G03	561.32	2953.50					X
	3420	007 G01	577.95	2954.10					X
	0240	004 J02	528.90	2951.30	X				
	0240	005 J02	532.60	2952.10	X				
	0240	006 J02	533.10	2951.10	X				
	0240	006 J09	533.10	2951.10	X				
	0240	007 G01	532.45	2951.80	X				
	0280	001 G01	591.32	2915.77	X				
	0280	002 G01	587.33	2918.35	X				
	1000	003 G01	590.02	2926.17	X				
	3340	001 G01	532.30	2964.20	X				
	3340	002 J03	533.20	2966.70	X				
	3420	005 G01	588.21	2949.02	X				
	3420	006 G01	561.32	2953.50	X				
	3420	008 J02	533.20	2953.40	X				
	3420	009 J02	526.00	2934.20	X				
	3420	010 J02	547.00	2939.30	X				
	3420	011 J02	544.90	2949.80	X				
	3420	012 J02	549.20	2960.60	X				
	3420	013 J02	534.00	2962.40	X				
	3420	014 J02	531.60	2958.40	X				
	3420	015 J02	537.10	2971.90	X				
	3425	001 G01	591.00	2969.07	X				
	4760	003 G01	593.48	2954.62	X				
	1720	002 J02	549.20	2947.80	X				
Martin	2620	004 F02	533.52	2995.82	X				
	4240	002 F01	575.55	3007.45	X				
	4240	002 G01	575.55	3007.45	X				
	4240	002 G09	575.55	3007.45	X				
	4240	003 G01	571.18	3007.95	X				
Hendry	0660	002 F01	505.90	2958.90	X				
	0660	002 J02	505.90	2958.90	X				
Highlands	1780	001 F03	465.05	3006.47	X				
Okeechobee	3180	002 F03	517.20	3018.00	X				
St. Lucie	1320	004 F01	563.98	3035.32	X				
	1320	004 F09	563.98	3035.32	X				
	1320	009 F02	562.50	3030.70	X				
	3745	001 F01	566.85	3020.32	X				
	3745	001 F09	566.85	3020.32	X				
Glades	No Monitoring Sites								

Source: FDER, 1989.

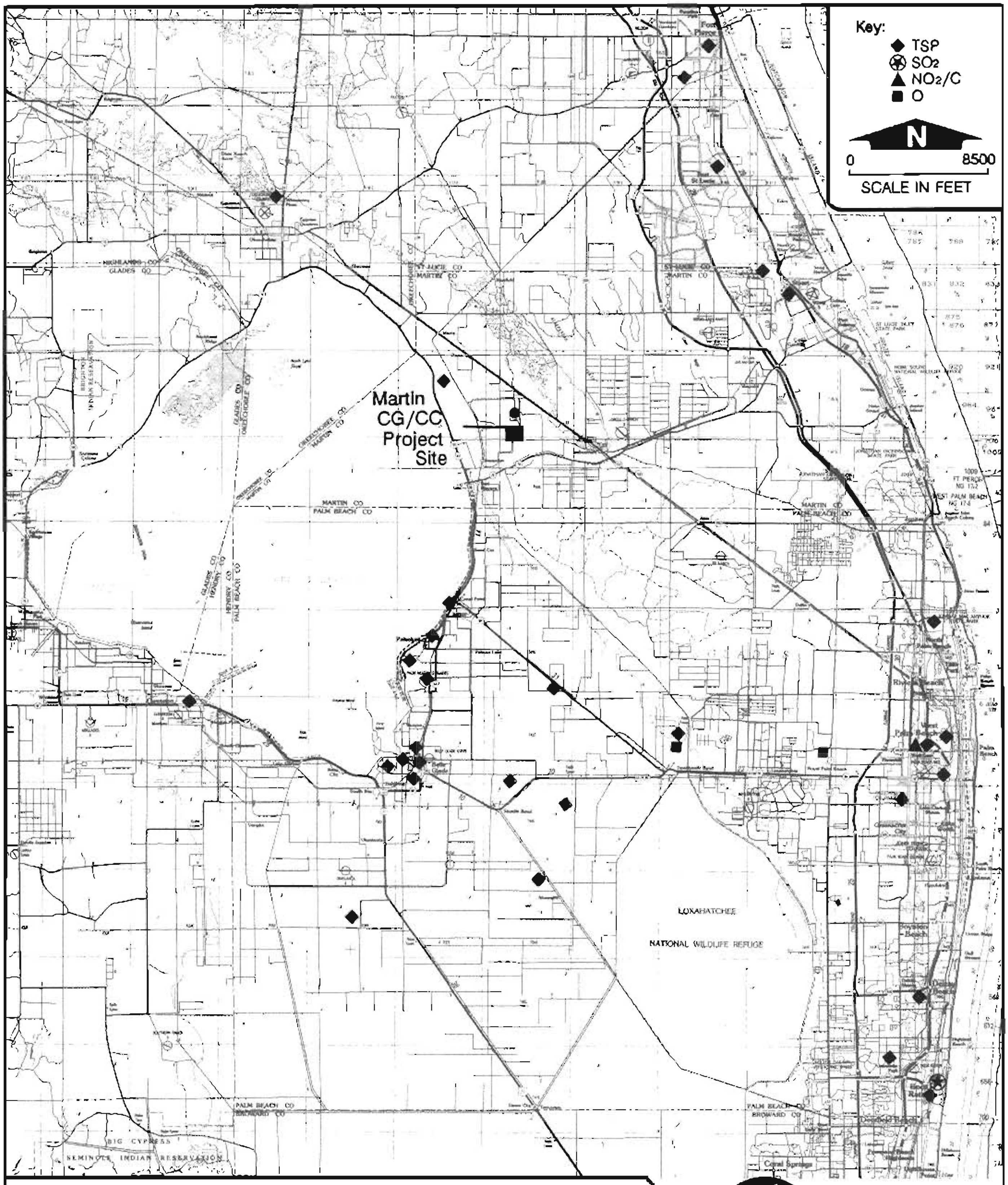


Figure 5-3
FDER AIR QUALITY MONITORING SITES
WITHIN THE MARTIN SITE REGION

Sources: FDER. 1988; Envirosphere Company, 1989

Martin
CG/CC
Project

FPL

Table 5-3. Summary of FDER Air Quality Monitoring Data for the Martin Site Vicinity for 1988

Pollutant	County	Averaging Period	Highest Concentration	EPA Standard	Florida Standard
CO	Palm Beach	1-Hr.	7(a)	35(a)	35(a)
		8-Hr.	5(a)	9(a)	9(a)
NO_2	Palm Beach	1-Hr.	137(b)	-	-
		Annual	25(b)	100(b)	100(b)
Ozone	Palm Beach	1-Hr.	0.107(a)	0.12(a)	0.12(a)
SO_2	Palm Beach	3-Hr.	58(b)	1300(b)	1300(b)
		24-Hr.	11(b)	365(b)	260(b)
		Annual	3(b)	80(b)	60(b)
Particulate Matter (TSP)	Hendry	24-Hr.	576(b)(e)	260(b)(c)	150(b)
		Annual	36(b)	75(b)(d)	60(b)
	Highlands	24-Hr.	143(b)	260	150
		Annual	20(b)	75	60
	Martin	24-Hr.	103(b)	260	150
		Annual	39(b)	75	60
	Okeechobee	24-Hr.	72(b)	260	150
		Annual	26(b)	75	60
	Palm Beach	24-Hr.	250(b)(f)	260	150
		Annual	50(b)	75	60
	St. Lucie	24-Hr.	189(b)(g)	260	150
		Annual	67(b)(g)	75	60

(a) Concentration in ppm.
(b) Concentration in ug/m^3.
(c) Primary standard specified with a secondary standard of 150 ug/m^3.
(d) Primary standard specified with a secondary standard of 60 ug/m^3.
(e) FDER indicated this exceedance was caused by reentrained particulate matter due to sugar cane harvesting activity and occurred on 12/17/88.
(f) FDER indicated this exceedance was caused by a fugitive dust event associated with a sugar cane transfer station operation on 12/17/88.
(g) FDER indicated these exceedances were due to fugitive dust emissions from a nearby cement plant and an asphalt plant and heavy vehicle traffic on 8/1/88.

Sources: FDER, 1988.
FDER, 1989.

5.3 Martin-Site Hourly Ambient Air Quality Monitoring Data Analysis and Summary

The existing air quality data collected in the Martin Site vicinity were deemed insufficient to support the PSD permit application. Therefore, a new on-site air quality monitoring program was conducted as previously described. The results from the first nine months of monitoring are described below.

Sulfur Dioxide

A tabulation of the hourly SO_2 concentrations measured at the Martin East and West sites during the period of October, 1988 through June, 1989 is presented in Appendix 10.5.6.4 and summarized in Table 5-4. A total of 5990 hourly averages were reported at the East site and 6169 hourly averages were reported at the West site. The percent data recovery was 91.4 percent and 94.2 percent for the East and West sites, respectively. As indicated in Table 5-4, SO_2 concentrations recorded for all averaging times for both sites are all well below the allowable NAAQS and FAAQS.

Ozone

A tabulation of hourly ozone concentrations measured during the period of October, 1988 through June, 1989, for the East and West sites is appended in Section 10.5.6.4. There were a total of 5831 hourly values reported for a data recovery of 89.0 percent for the East site and 6279 hourly values reported for a data recovery of 95.8 percent for the West site. The data summarized in Table 5-4 indicate that recorded values were well within the allowable NAAQS and FAAQS.

Nitrogen Dioxide

A tabulation of hourly NO_2 concentrations measured at the East and West sites during the period of October, 1988 through June,

Table 5-4. Summary of FPL Martin On-Site Air Quality Monitoring Data for the Period October 1988 through June 1989

Pollutant	Averaging Period	Highest Monitored Concentration (ug/m^3)	Monitoring Site	EPA Standard (ug/m^3)	Florida Standard (ug/m^3)
SO_2	3-Hr.	31	West	1300	1300
	24-Hr.	10	East	365	260
	9-Mo. (Annual Standard)	2	East	80	60
Ozone	1-Hr.	165	East	235	235
	9-Mo. (Annual Standard)	65	West	-	-
NO_2	1-Hr.	62	West	-	-
	9-Mo. (Annual Standard)	10	East	100	100
Particulate Matter(PM)	24-Hr.	39	East	150	150
	9-Mo. (Annual Standard)	14	West	50	50

Sources: Envirosphere Company, 1989.
Envirosphere Company, 1989a
Envirosphere Company, 1989b

1989 is presented in Appendix 10.5.6.4. At the East site, there were a total of 5793 hourly values reported which represents a data recovery of 88.4 percent. There were a total of 6100 hourly values reported at the West site, which represents a data recovery of 93.1 percent. The data summarized in Table 5-4 demonstrate that on-site background NO_2 concentrations are very low in comparison with the NAAQS and FAAQS.

Particulate Matter (PM_{10})

Sampling for PM_{10} was performed on a once every sixth day basis. The monitoring results are summarized in Table 5-4 and presented in Appendix 10.5.6.5. The data indicate that background particulate matter concentrations are well below the NAAQS and FAAQS. Thirty-nine valid samples were recovered from the primary sampler at the East site for a data recovery of 86.7 percent, while 36 valid samples were collected at the West site, representing a data recovery of 80.0 percent.

5.4 Martin-Site Hourly Meteorological Monitoring Data Analysis and Summary

Wind Speed (10 meters)

The 10-meter wind speed data collected during the period of October, 1988 through June, 1989 are presented in Appendix 10.5.6.2. There were 5,971 hourly averages reported during this period which represents a data recovery rate of 91.1 percent. The average wind speed during this period was 4.1 mph, (1.8 meters per second). The maximum hourly average wind speed was 18.0 mph (8.0 meters per second). The average wind speed recorded at West Palm Beach for this period was 11.7 mph (5.2 meters per second) with a maximum observed wind speed (peak gust) of 47 mph (21 meters per second).

Wind Direction (10 meters)

The 10-meter wind direction data collected during the period of October, 1988 through June, 1989 are presented in Appendix 10.5.6.2. There were 6,229 hourly averages reported for a data recovery rate of 95.1 percent. The prevailing winds during this period were from the north, north-northeast and north-northwest as shown in Figure 5-4, which is an on-site wind rose for the nine-month period. Wind direction data for this same period recorded at the West Palm Beach NWS Station indicated prevailing winds from the north-northwest, east and southeast as shown in Figure 5-5.

Ambient Temperature (10 meters)

A total of 6,331 hourly averages were reported during the period of October, 1988 through June 1989. This represents a data recovery rate of 96.6 percent. The maximum hourly average of 33.5°C (92.3°F) was recorded on June 8, 1989. An hourly average of 0.0°C (32.0°F), recorded on February 25, 1989 was the minimum for the period. The average daily temperature for the period monitored was 22.0°C (71.6°F). The hourly values collected during the period are presented in Appendix 10.5.6.2 and the data are summarized in Table 5-5.

Sigma Theta (10 meters)

Table 5-6 presents a summary by month of the frequency distribution of various stability classes developed using the on-site sigma theta data and the classification scheme presented in the U.S. EPA Guideline on Air Quality Models (U.S. EPA, 1987). The actual data collected are presented Appendix 10.5.6.2. There are 5,556 values reported for the period of October, 1988 through June, 1989, representing a data recovery rate of 84.8 percent.

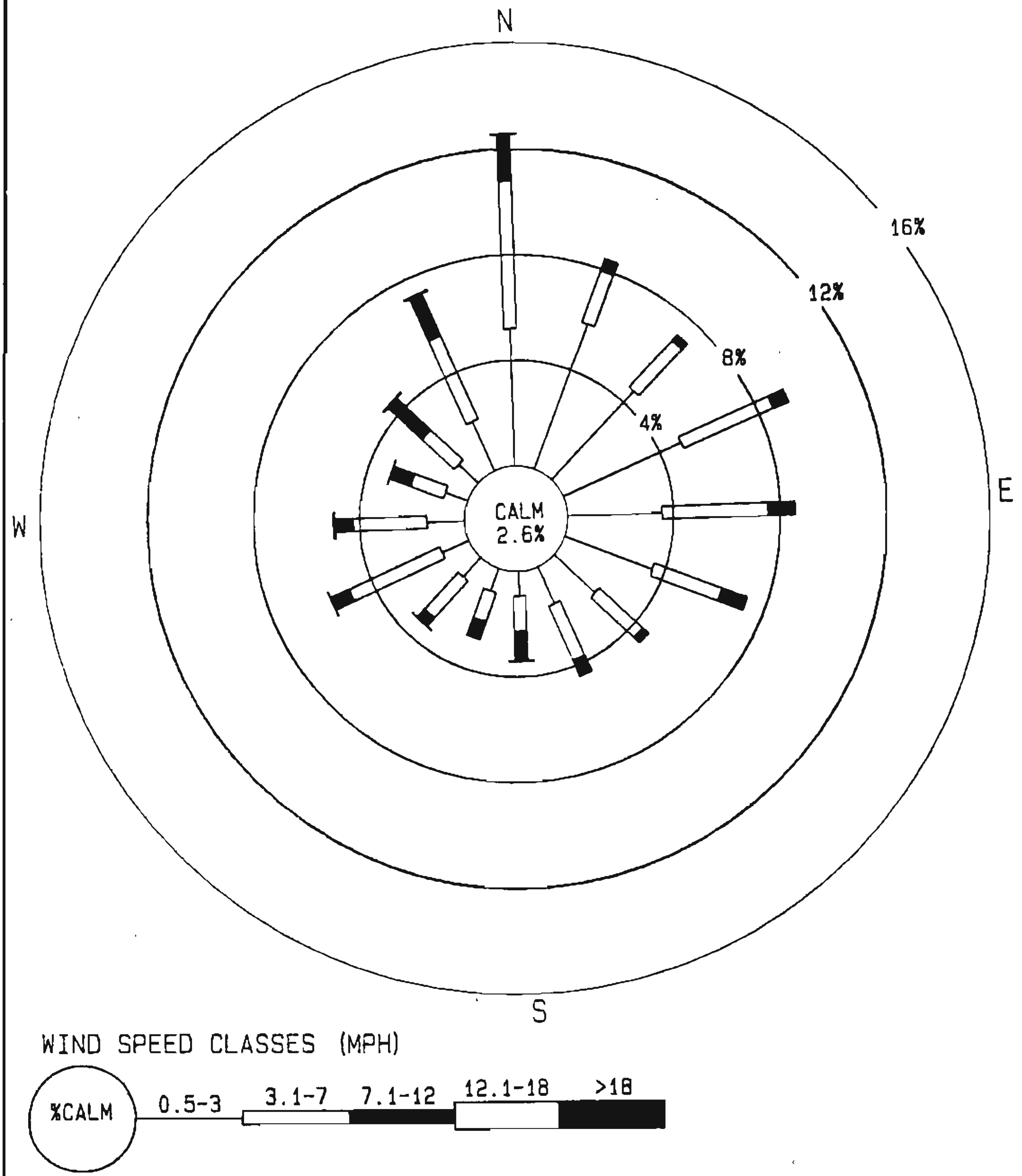


Figure 5-4
WIND ROSE MARTIN SITE
OCTOBER 1988-JUNE 1989

Martin
CG/CC
Project
FPL

Source: Envirosphere Company, 1989

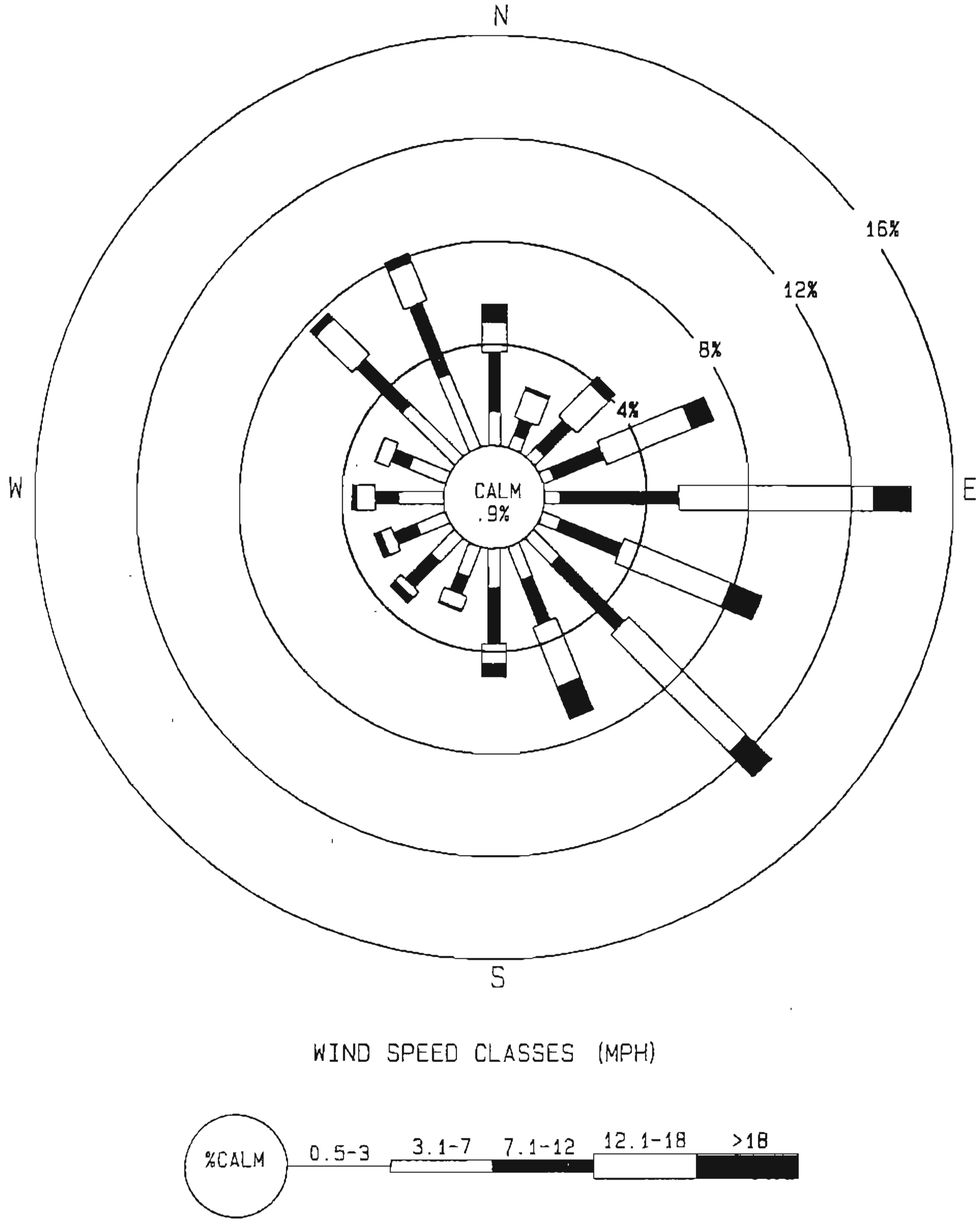


Figure 5-5
WIND ROSE WEST PALM BEACH
OCTOBER 1988-JUNE 1989

Source: Envirosphere Company, 1989

Martin
CG/CC
Project

FPL

Table 5-5. Diurnal and Monthly Temperature Means and Extremes °F (°C), Martin On-Site Data for October 1988 - June 1989

Month	Year	Daily[1] Maximum	Daily[2] Minimum	Monthly Average	Highest Recorded	Lowest Recorded
October	1988	85.6 (29.8)	68.5 (20.3)	76.3 (24.6)	91.2 (32.9)	62.4 (16.9)
November	1988	82.8 (28.2)	66.4 (19.1)	73.9 (23.3)	88.2 (31.2)	52.3 (11.3)
December	1988	76.5 (24.7)	59.2 (15.1)	67.3 (19.6)	84.7 (29.3)	40.8 (4.9)
January	1989	77.9 (25.5)	60.3 (15.7)	68.5 (20.3)	86.0 (30.0)	52.3 (11.3)
February	1989	74.7 (23.7)	55.4 (13.0)	64.8 (18.2)	86.2 (30.1)	32.0 (0.0)
March	1989	78.3 (25.7)	60.4 (15.8)	69.1 (20.6)	85.6 (29.8)	46.6 (8.1)
April	1989	81.7 (27.6)	62.8 (17.1)	71.6 (22.0)	86.5 (30.3)	52.9 (11.6)
May	1989	85.6 (29.8)	66.9 (19.4)	76.3 (24.6)	90.3 (32.4)	57.4 (14.1)
June	1989	86.6 (30.0)	69.4 (20.8)	77.2 (25.1)	92.3 (33.5)	65.1 (18.4)

(1) Average of Daily Hourly Maximums

(2) Average of Daily Hourly Minimums

Sources: Envirosphere Company, 1989
Envirosphere Company, 1989a
Envirosphere Company, 1989b

Table 5-6. Modified Sigma Theta (MST) Stability Classes, Martin On-Site Data for October 1988-June 1989

Month	Stability Class and Range					
	A	B	C	D	E	F
	Extremely Unstable >22.4°	Very Unstable 17.5° - 22.4°	Unstable 12.5° - 17.4°	Neutral 7.5° - 12.4°	Stable 3.8° - 7.4°	Very Stable <3.8°
October 1988	9.9	10.3	14.1	32.9	21.8	10.9
November 1988	8.3	10.8	11.7	32.0	24.5	12.8
December 1988	17.3	6.1	6.0	18.3	17.8	34.6
January 1989	17.8	9.4	8.6	14.4	21.1	29.0
February 1989	14.8	9.6	10.3	25.3	16.0	24.4
March 1989	18.0	17.1	12.5	19.3	16.5	16.9
April 1989	20.0	11.7	5.7	15.4	17.1	30.3
May 1989	23.7	14.1	8.0	13.1	13.4	27.7
June 1989	23.5	16.2	6.0	3.5	17.1	33.7

Units: Percent occurrence

Sources: Envirosphere Company, 1989.
Envirosphere Company, 1989a.
Envirosphere Company, 1989b.

Relative Humidity (10 meters)

The hourly relative humidity values collected at the Martin Site for the period of October, 1988 through June, 1989 are appended in Appendix 10.5.6.2 and summarized in Table 5-7. There were a total of 5,625 hourly averages reported which represent a data recovery rate of 85.8 percent. The maximum on-site relative humidity was 100 percent and the minimum was 10 percent.

Table 5-7. Diurnal Relative Humidity, Martin On-Site Data for October 1988 - June 1989

Month	Relative Humidity (%) Daytime[(1)]	Relative Humidity (%) Nighttime[(2)]
October, 1988	45	90
November, 1988	52	88
December, 1988	49	72
January, 1989	54	91
February, 1989	39	86
March, 1989	48	95
April, 1989	38	95
May, 1989	43	89
June, 1989	63	100

(1) Average midday, 12:00 noon

(2) Average pre-dawn, 6:00 a.m.

Sources: Envirosphere Company, 1989
Envirosphere Company, 1989a
Envirosphere Company, 1989b

6.0 AIR QUALITY MODELING APPROACH

This section summarizes the air quality modeling protocol and input parameters utilized in the air impact determinations presented in Section 7.0. Included are descriptions of the models, meteorology, options selected, listings of modeling parameters for the proposed facilities, receptor locations, and step-by-step proceedures that were used to identify the necessary results.

The scope of the required modeling analysis is limited to those pollutants that were determined to be subject to PSD review in Section 3.0 (SO_2, PM, NO_x, CO, O_3, Pb, Be, Hg, and As). Not all of these pollutants will require the full PSD air quality analysis; for some, it will be sufficient to identify impacts of the new facilities alone.

As indicated in Table 3-2, there will be a significant increase in VOC emissions, triggering PSD review for ozone. However, the U.S. EPA Guideline on Air Quality Models (U.S. EPA, 1987) indicates that "the use of models incorporating complex chemical mechanisms should be considered only on a case-by-case basis with proper demonstration of applicability. These are generally regional models not designed for the evaluation of individual sources but used primarily for region-wide evaluations." This statement and the fact that the proposed facility is not located in an ozone non-attainment area preclude subjecting the proposed facility to a VOC emissions impact assessment.

The proposed source emissions of Be, Hg, and As are shown in Table 3-2 to be above the PSD significant emission rates. However, the PSD regulations do not define significant impact levels for these pollutants nor are ambient air quality standards established for these pollutants. Hence, the air quality impact assessment for these pollutants is limited to prediction of the maximum impacts from the proposed facility.

Some additional pollutants that are not subject to PSD review (and not regulated under the Clean Air Act) are included in the air quality impact analysis in order to provide additional information, and to serve as input to additional impacts analysis in Section 8.0. The additional noncriteria pollutants for which emissions estimates were available for this project (mainly trace elements) are cadmium (Cd), chromium (Cr), copper (Cu), formaldehyde, manganese (Mn), nickel (Ni), polycyclic organic matter (POM), selenium (Se), vanadium (V), and zinc (Zn). Emissions estimates for these substances were presented in Section 2.0.

6.1 General Modeling Approach

The air quality impact assessment consists of a proposed source significant impact area analysis, a PSD increment consumption analysis, an ambient air quality standards impact analysis, and an additional impacts analysis. These analyses are discussed in greater detail below under specific modeling methodology. The modeling approach followed EPA and FDER modeling guidelines for determining compliance with applicable PSD increments and ambient air quality standards. A modeling protocol was prepared by the applicant and submitted to FDER for review. The FDER approved the modeling protocol prior to commencement of the air quality impact assessment (Rogers, 1989).

Based on current EPA and FDER policies, the highest annual average and highest second-highest short-term (i.e., 24 hours or less) predicted (critical) concentrations were selected for comparison to applicable standards. The use of a five-year meteorological data base in the modeling analysis allowed for a comparison of the predicted highest second-highest short-term concentration to applicable short-term PSD increments and ambient air quality standards. The highest second-highest concentration was calculated for a receptor field by:

- Eliminating the highest concentration predicted at each receptor,
- Identifying the second-highest concentration predicted at each receptor, and
- Selecting the highest concentration among those second-highest concentrations.

This approach is consistent with the air quality standards and PSD increments which permit one short-term average exceedance per year at each receptor.

The general modeling approach for each air quality impact analysis consisted of a screening phase and a refined phase. The major difference between the two phases is the receptor grid used when predicting concentrations and the number of meteorological data periods evaluated. In general, concentrations for the screening phase analysis were predicted using a coarse mesh receptor grid and a five-year meteorological data base. The screening phase analysis identified the critical receptors associated with highest and highest second-highest short-term concentrations for all applicable pollutants and averaging periods which were evaluated further in greater detail in the refined phase of the modeling analysis.

The refined phase of the modeling analysis was performed by predicting concentrations using a fine mesh receptor grid centered over each of the critical receptors identified in the screening phase of the modeling analysis. The refined phase analysis used only the Julian days or full years of meteorological data containing the meteorological conditions which caused the critical concentrations identified for analysis in the screening phase. This approach was used to ensure that valid highest second-highest (critical) short-term concentrations were obtained for comparison to applicable air quality standards and PSD increments. Table 3-1 presents a summary of the ambient air quality standards and PSD increments.

6.2 Model Selection and Options

Dispersion Model Selection

The Martin Site has been determined to be a rural area based upon the technique for urban/rural determinations documented in the EPA "Guideline on Air Quality Models" (U.S. EPA, 1987) which applies land use criteria. Based upon this determination, the refined ISCST dispersion model (UNAMAP 6, version 3.4, issued on Julian Day 348 of 1988 [88348]) was selected for application in the air quality impact analysis used to support the PSD permit application. The ISCST model is a referenced EPA dispersion model recommended for use in rural areas, and for application to point, area, and volume sources. The ISCST model can predict the maximum as well as the highest second-highest concentration and period of occurrence for 1-hour, 3-hour, 8-hour, 24-hour, and annual averaging periods at each receptor for each full year of hourly meteorological data used.

Dispersion Model Options

Refer to Table 6-1 for a listing of the program control parameter data used in the ISCST model as approved by FDER (Rogers, 1989). The ISCST model was applied without terrain adjustment data because the area in which the Martin Site is located has very little relief (e.g., a net change in ground level elevation of 10 feet). The ISCST model's building downwash option was not applied because the stacks for the proposed source, assuming the worst-case emissions scenario, and the background sources were modeled assuming GEP stack height credit.

Based on a discussion with FDER (Rogers, 1989c), approval was granted to co-locate all stacks (HRSG's, diesel generators, auxiliary boilers, and incinerators) for the proposed facility in the modeling analysis. It was noted that under the worst-case pollutant emissions scenarios, the pollutant emissions for the diesel generators and auxiliary boilers are sufficiently small compared to the HRSG stacks' emissions to allow co-location of the proposed sources. Hence, the total worst-case emissions for all proposed sources were assumed to be emitted from one stack having the HRSG stack parameters.

Because all proposed sources were co-located, emissions impacts for the proposed source with respect to all applicable pollutants were scaled with reference to emissions of a single pollutant (SO_2). The ISCST model was run separately for the background PSD sources and the background baseline sources to determine those source contributions in combination with the proposed source impacts.

Table 6-1. FPL Martin ISCST Model Program Control Parameter Data (Page 1 of 2)

Calculate (concentration = 1, deposition = 2)	ISW(1) =	1
Receptor grid system (cartesian = 1 or 3, polar = 2 or 4)	ISW(2) =	1,3,4
Discrete receptor system (cartesian = 1, polar = 2)	ISW(3) =	1,2
Terrain elevations are read (yes = 1, no = 0)	ISW(4) =	0
Calculations are written to tape (yes = 1, no = 0)	ISW(5) =	0
List all input data (no = 0, yes = 1, met data also = 2)	ISW(6) =	1,2
Complete average concentration (or total deposition) with the following time periods:		
Hourly (yes = 1, no = 0)	ISW(7) =	1
2-hour (yes = 1, no = 0)	ISW(8) =	0
3-hour (yes = 1, no = 0)	ISW(9) =	1
4-hour (yes = 1, no = 0)	ISW(10) =	0
6-hour (yes = 1, no = 0)	ISW(11) =	0
8-hour (yes = 1, no = 0)	ISW(12) =	1
12-hour (yes = 1, no = 0)	ISW(13) =	0
24-hour (yes = 1, no = 0)	ISW(14) =	1
Print "N" - day tables (yes = 1, no = 0)	ISW(15) =	1
Print the following types of tables whose time periods are specified by ISW(7) through ISW (14):		
Daily tables (yes = 1, no = 0)	ISW(16) =	0
Highest and second-highest tables (yes = 1, no = 0)	ISW(17) =	1
Maximum 50 tables (yes = 1, no = 0)	ISW(18) =	1
Meteorological data input method (preprocessed = 1, card = 2)	ISW(19) =	1
Rural-urban option (ru. = 0, ur. mode 1 = 1, ur. mode 2 = 2, ur. mode 3 = 3)	ISW(20) =	0
Wind profile exponent values (defaults = 1, user enters = 2,3)	ISW(21) =	1
Vertical pot. temp. gradient values (defaults = 1, user enters = 2,3)	ISW(22) =	1
Scale emission rates for all sources (no = 0, yes > 0)	ISW(23) =	0
Program calculates final plume rise only (yes = 1, no = 2)	ISW(24) =	1
Program adjusts all stack heights for downwash (yes = 2, no = 1)	ISW(25) =	2
Program uses buoyancy induced dispersion (yes = 1, no = 2)	ISW(26) =	1

Table 6-1. FPL Martin ISCST Model Program Control Parameter Data (Page 2 of 2)

Concentrations during calm periods set = 0 (yes = 1, no = 2)	ISW(27) =	1
Regulatory default option chosen (yes = 1, no = 2)	ISW(28) =	1
Type of pollutant to be modeled (1 = SO_2, 2 = other)	ISW(29) =	1,2
Debug option chosen (yes = 1, no = 2)	ISW(30) =	1
Above ground (flagpole) receptors used (yes = 1, no = 0)	ISW(31) =	0
Number of input sources	NSOURC =	variable
Number of source groups (=0, all sources)	NGROUP =	variable
Time period interval to be printed (=0, all intervals)	IPER =	0
Number of X (range) grid values	NXPNTS =	variable
Number of Y (theta) grid values	NYPNTS =	variable
Number of discrete receptors	NXWYPT =	variable
Source emission rate units conversion factor	TK =	1×10^6
Height above ground at which wind speed was measured	ZR =	6.7 meters
Logical unit number of meteorological data	IMET =	9
Decay coefficient for physical or chemical depletion	DECAY =	0.0
Surface met. station number	ISS =	12844
Year of surface met. data	ISY =	1982-1986
Upper air met. station number	IUS =	12844
Year of upper air met. data	IUY =	1982-1986

Source: Envirosphere, 1989b.

The ISCST model was applied in the area source mode to assess air quality impacts for fugitive dust generated by aggregate handling and storage facilities associated with the proposed source. The ISCST model was also applied to assess the air quality impacts for fugitive dust generated from a slag transfer conveyor system associated with the proposed source. The model was run to assess the slag transfer conveyor system as a volume line source as recommended by FDER.

The air quality impact assessment for PM assumed that all PM emissions were total suspended particulates (TSP) and not PM_{10} emissions. This assumption simplified the PM modeling analysis and was approved by FDER (Rogers, 1989b). This assumption makes for a conservative approach to modeling PM impacts and was justified by the fact that PM_{10} emission factors for wind erosion of aggregate storage piles had not been applied widely in modeling analyses supporting PSD permit applications and in some cases EPA guidance in applying the emission factors was lacking or non-existent. In the event TSP impacts violated PM_{10} ambient air quality standards or TSP PSD increments, the ISCST model was applied assuming emission control credit for fugitive dust emissions wherever possible to demonstrate attainment of PSD increments and ambient air quality standards.

A more detailed discussion of the ISCST model options and input data requirements is presented in the ISCST model user's guide (U.S. EPA, 1987a). The air quality modeling strategy for all of these sources is discussed in greater detail below.

6.3 Meteorological Data

The air quality modeling analysis used hourly preprocessed National Weather Service (NWS) surface meteorological data and concurrent twice-daily upper air soundings from West Palm

Beach, Florida for the years 1982-1986. The hourly surface data and upper air soundings were preprocessed using the RAMMET meteorological data preprocessor computer program as required by EPA to develop an hourly sequential meteorological data file for each year of record used as input to the ISCST model. The preprocessed hourly meteorological data file for each year of record used in the analysis contains randomized wind direction, wind speed, ambient temperature, atmospheric stability using the Turner (1970) stability classification scheme, and mixing heights. The anemometer height of 6.7 meters, used in the modeling analysis, was obtained from NWS Local Climatological Data summaries for West Palm Beach.

6.4 Emissions Inventory

Proposed Source

The proposed CG/CC facility will have the capability of firing natural gas, No. 2 distillate fuel oil, and coal-derived gas. The fuel scenarios evaluated for the proposed source include natural gas firing at 100% load at 40°F and 95°F ambient temperature, No. 2 distillate fuel oil firing at 100% load at 40°F and 95°F ambient temperature, and coal-derived gas firing at 100% load at 75°F ambient temperature. The proposed facility will also include two auxiliary boilers capable of firing natural gas and fuel oil and two diesel generators firing diesel fuel. Additional emissions will occur from four incinerator stacks during coal gas production.

The emissions inventories for the proposed source fuel scenarios identified above are presented in Tables 6-2 through 6-10. The pollutant emission rates shown in those tables are representative of Best Available Control Technology (BACT) as demonstrated in Section 4.0. The air quality modeling analysis for the proposed source assumed that maximum design capacity

Table 6-2. Proposed Source Emissions Inventory - Natural Gas at 40°F Ambient Temperature

Source ID Number[1]	UTM Coordinates (km) East	North	Stack Parameters[2] H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	Emission Rates (grams/sec.)[3] SO_2	PM	NO_2	CO	Pb
CT 3A	542.87	2992.43	65.0	411	18.6	6.1	11.5	2.3	36.3	19.8	neg.
CT 3B	542.90	2992.43	65.0	411	18.6	6.1	11.5	2.3	36.3	19.8	neg.
CT 4A	542.97	2992.43	65.0	411	18.6	6.1	11.5	2.3	36.3	19.8	neg.
CT 4B	543.00	2992.43	65.0	411	18.6	6.1	11.5	2.3	36.3	19.8	neg.
CT 5A	543.10	2992.43	65.0	411	18.6	6.1	11.5	2.3	36.3	19.8	neg.
CT 5B	543.13	2992.43	65.0	411	18.6	6.1	11.5	2.3	36.3	19.8	neg.
CT 6A	543.20	2992.43	65.0	411	18.6	6.1	11.5	2.3	36.3	19.8	neg.
CT 6B	543.23	2992.43	65.0	411	18.6	6.1	11.5	2.3	36.3	19.8	neg.
CT[4]	543.05	2992.43	65.0	411	18.6	6.1	105.6	19.1	300.9	161.0	neg.

(1) CT = Combined cycle combustion turbine.

(2) Stack height (H_s), stack exit temperature (T_s), Stack exit velocity (V_s), and stack exit diameter (D_s).

(3) Co-located proposed source stack emissions include worst-case emissions for diesel generators and auxiliary boilers. See Tables 6-8 and 6-9 for details.

(4) Co-located CT stack parameters and emissions data. Note, the receptor grid reference coordinates for the co-located stack are x, +180 m.; Y, 0.0 m.

Table 6-3. Proposed Source Emissions Inventory - Natural Gas at 95°F Ambient Temperature

	UTM Coordinates (km)		Stack Parameters[2]				Emission Rates (grams/sec.)[3]				
Source ID Number[1]	East	North	H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	SO_2	PM	NO_2	CO	Pb
CT 3A	542.87	2992.43	65.0	411	16.5	6.1	10.0	2.1	30.6	17.0	neg.
CT 3B	542.90	2992.43	65.0	411	16.5	6.1	10.0	2.1	30.6	17.0	neg.
CT 4A	542.97	2992.43	65.0	411	16.5	6.1	10.0	2.1	30.6	17.0	neg.
CT 4B	543.00	2992.43	65.0	411	16.5	6.1	10.0	2.1	30.6	17.0	neg.
CT 5A	543.10	2992.43	65.0	411	16.5	6.1	10.0	2.1	30.6	17.0	neg.
CT 5B	543.13	2992.43	65.0	411	16.5	6.1	10.0	2.1	30.6	17.0	neg.
CT 6A	543.20	2992.43	65.0	411	16.5	6.1	10.0	2.1	30.6	17.0	neg.
CT 6B	543.23	2992.43	65.0	411	16.5	6.1	10.0	2.1	30.6	17.0	neg.
CT[4]	543.05	2992.43	65.0	411	16.5	6.1	93.6	17.8	255.4	138.6	neg.

(1) CT = Combined cycle combustion turbine.

(2) Stack height (H_s), stack exit temperature (T_s), Stack exit velocity (V_s), and stack exit diameter (D_s).

(3) Co-located proposed source stack emissions include worst-case emissions for diesel generators and auxiliary boilers. See Tables 6-8 and 6-9 for details.

(4) Co-located CT stack parameters and emissions data. Note, the receptor grid reference coordinates for the co-located stack are x, +180 m.; Y, 0.0 m.

Table 6-4. Proposed Source Emissions Inventory - No. 2 Fuel Oil at 40°F Ambient Temperature

	UTM Coordinates (km)		Stack Parameters[2]				Emission Rates (grams/sec.)				
Source ID Number[1]	East	North	H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	SO_2	PM	NO_2	CO	Pb
CT3A	542.87	2992.43	65.0	411	18.8	6.1	115.9	7.6	58.1	20.2	0.002
CT3B	542.90	2992.43	65.0	411	18.8	6.1	115.9	7.6	58.1	20.2	0.002
CT4A	542.97	2992.43	65.0	411	18.8	6.1	115.9	7.6	58.1	20.2	0.002
CT4B	543.00	2992.43	65.0	411	18.8	6.1	115.9	7.6	58.1	20.2	0.002
CT5A	543.10	2992.43	65.0	411	18.8	6.1	115.9	7.6	58.1	20.2	0.002
CT5B	543.13	2992.43	65.0	411	18.8	6.1	115.9	7.6	58.1	20.2	0.002
CT6A	543.20	2992.43	65.0	411	18.8	6.1	115.9	7.6	58.1	20.2	0.002
CT6B	543.23	2992.43	65.0	411	18.8	6.1	115.9	7.6	58.1	20.2	0.002
CT[3]	543.05	2992.43	65.0	411	18.8	6.1	940.8	61.1	475.2	164.2	0.017

(1) CT = Combined cycle combustion turbine.

(2) Stack height (H_s), stack exit temperature (T_s), Stack exit velocity (V_s), and stack exit diameter (D_s).

(3) Co-located proposed source stack emissions include worst-case emissions for diesel generators and auxiliary boilers. See Tables 6-8 and 6-9 for details. Note, the receptor grid reference coordinates for the co-located stack are x, +180 m.; Y, 0.0 m.

Table 6-5. Proposed Source Emissions Inventory - No. 2 Fuel at 95°F Ambient Temperature

Source ID	UTM Coordinates (km)		Stack Parameters[2]				Emission Rates (grams/sec.)[3]				
Number[1]	East	North	H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	SO_2	PM	NO_2	CO	Pb
CT 3A	542.87	2992.43	65.0	411	16.7	6.1	100.8	6.9	49.4	17.1	0.002
CT 3B	542.90	2992.43	65.0	411	16.7	6.1	100.8	6.9	49.4	17.1	0.002
CT 4A	542.97	2992.43	65.0	411	16.7	6.1	100.8	6.9	49.4	17.1	0.002
CT 4B	543.00	2992.43	65.0	411	16.7	6.1	100.8	6.9	49.4	17.1	0.002
CT 5A	543.10	2992.43	65.0	411	16.7	6.1	100.8	6.9	49.4	17.1	0.002
CT 5B	543.13	2992.43	65.0	411	16.7	6.1	100.8	6.9	49.4	17.1	0.002
CT 6A	543.20	2992.43	65.0	411	16.7	6.1	100.8	6.9	49.4	17.1	0.002
CT 6B	543.23	2992.43	65.0	411	16.7	6.1	100.8	6.9	49.4	17.1	0.002
CT[4]	543.05	2992.43	65.0	411	16.7	6.1	820.0	55.3	405.8	139.4	0.016

(1) CT = Combined cycle combustion turbine.

(2) Stack height (H_s), stack exit temperature (T_s), stack exit velocity (V_s), and stack exit diameter (D_s).

(3) Co-located proposed source stack emissions include worst-case emissions for diesel generators and auxiliary boilers. See Tables 6-8 and 6-9 for details.

(4) Co-located CT stack parameters and emissions data. Note, the receptor grid reference coordinates for the co-located stack are x, +180 m.; Y, 0.0 m.

Table 6-6. Proposed Source Emissions Inventory - Coal-Derived Gas - 100% Load at 75° Ambient Temperature

	UTM Coordinates (km)		Stack Parameters[2]				Emission Rates (grams/sec.)[3]				
Source ID Number[1]	East	North	H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	SO_2	PM	NO_2	CO	Pb
CT 3A	542.87	2992.43	65.0	394	20.1	6.1	105.1	2.4	49.4	25.5	0.038
CT 3B	542.90	2992.43	65.0	394	20.1	6.1	105.1	2.4	49.4	25.5	0.038
CT 4A	542.97	2992.43	65.0	394	20.1	6.1	105.1	2.4	49.4	25.5	0.038
CT 4B	543.00	2992.43	65.0	394	20.1	6.1	105.1	2.4	49.4	25.5	0.038
CT 5A	543.10	2992.43	65.0	394	20.1	6.1	105.1	2.4	49.4	25.5	0.038
CT 5B	543.13	2992.43	65.0	394	20.1	6.1	105.1	2.4	49.4	25.5	0.038
CT 6A	543.20	2992.43	65.0	394	20.1	6.1	105.1	2.4	49.4	25.5	0.038
CT 6B	543.23	2992.43	65.0	394	20.1	6.1	105.1	2.4	49.4	25.5	0.038
CT[4]	543.05	2992.43	65.0	394	20.1	6.1	870.1	20.1	436.5	206.6	0.328

(1) CT = Combined cycle combustion turbine.

(2) Stack height (H_s), stack exit temperature (T_s), Stack exit velocity (V_s), and stack exit diameter (D_s).

(3) Co-located proposed source stack emissions include worst-case emissions for diesel generators, auxiliary boilers, and gasifier incinerators. See Tables 6-8, 6-9, and 6-10 for details.

(4) Co-located CT stack parameters and emissions data. Note, the receptor grid reference coordinates for the co-located stack are x, +180 m.; Y, 0.0 m.

Table 6-7. Proposed Source Emissions Inventory - Auxiliary Boiler - Natural Gas

Source ID	UTM Coordinates (km)		Stack Parameters[2]				Emission Rates (grams/sec.)				
Number[1]	East	North	H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	SO_2	PM	NO_2	CO	Pb
AB1	542.95	2992.47	18.3	527	15.2	1.1	Trace	0.1	0.9	0.5	neg.
AB2	543.18	2992.47	18.3	527	15.2	1.1	Trace	0.1	0.9	0.5	neg.

(1) AB = Auxiliary boiler.

(2) Stack height (H_s), stack exit temperature (T_s), stack exit velocity (V_s), and stack exit diameter (D_s).

Table 6-8. Proposed Source Emissions Inventory - Auxiliary Boiler - Fuel Oil

	UTM Coordinates (km)		Stack Parameters[2]				Emission Rates (grams/sec.)				
Source ID Number[1]	East	North	H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	SO_2	PM	NO_2	CO	Pb
AB1	542.95	2992.47	18.3	535	15.2	1.1	6.5	0.2	1.4	0.5	neg.
AB2	543.18	2992.47	18.3	535	15.2	1.1	6.5	0.2	1.4	0.5	neg.
AB[3]	543.05	2992.43	--	--	--	--	12.9	0.4	2.7	0.9	neg.

(1) AB = Auxiliary boiler.

(2) Stack height (H_s), stack exit temperature (T_s), stack exit velocity (V_s), and stack exit diameter (D_s).

(3) Total worst-case auxiliary boiler emissions are combined with the co-located CT stack emissions shown in Table 10.1.5-31.

Table 6-9. Proposed Source Emissions Inventory - Diesel Generator - Diesel Fuel

Source ID Number[1]	UTM Coordinates (km) East	UTM Coordinates (km) North	Stack Parameters[2] H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	Emission Rates (grams/sec.) SO_2	PM	NO_2	CO	Pb
DG1	542.95	2992.47	7.6	786	39.6	0.3	0.3	0.3	3.9	0.8	neg.
DG2	543.18	2992.47	7.6	786	39.6	0.3	0.3	0.3	3.9	0.8	neg.
DG[3]	543.05	2992.43	--	--	--	--	0.5	0.6	7.8	1.7	neg.

[1] DG = Diesel generator.

[2] Stack height (H_s), stack exit temperature (T_s), stack exit velocity (V_s), and stack exit diameter (D_s).

[3] Total worst-case diesel generator emissions are combined with the co-located CT stack emissions shown in Tables 6-2 through 6-6.

Table 6-10. Proposed Source Emissions Inventory - Coal Gasification Tail Gas Incinerator - 100% Load at 75° Ambient Temperature

	UTM Coordinates (km)		Stack Parameters[2]				Emission Rates (grams/sec.)[3]				
Source ID Number[1]	East	North	H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	SO_2	PM	NO_2	CO	Pb
CG 3	543.02	2992.22	22.9	922	9.1	2.3	4.0	neg.	7.7	neg.	0.0063
CG 4	543.19	2992.22	22.9	922	9.1	2.3	4.0	neg.	7.7	neg.	0.0063
CG 5	543.68	2992.22	22.9	922	9.1	2.3	4.0	neg.	7.7	neg.	0.0063
CG 6	543.85	2992.22	22.9	922	9.1	2.3	4.0	neg.	7.7	neg.	0.0063
CG[3]	543.44	2992.22	--	--	--	--	16.0	neg.	30.8	neg.	0.0252

(1) CG = Coal gasificatiion incinerator stack

(2) Stack height (H_s), stack exit temperature (T_s), Stack exit velocity (V_s), and stack exit diameter (D_s).

(3) Total worst-case incinerator stack emissions are combined with the co-located CT stack emissions (during coal gas firing) shown in Table 6-6.

emissions represent actual emissions for purposes of determining PSD increment consumption.

The proposed source worst-case fuel scenario was determined by first modeling the two scenarios with the highest emissions (No. 2 distillate fuel oil, 100% load, 40°F and coal-derived gas, 100% load, 75°F) using a coarse receptor grid composed of 493 receptors and five years of meteorological data, as described above, in the ISCST model. The results of that analysis indicated 1984 to be the worst-case year of meteorological data for the short-term air quality impacts (24-hours or less) and 1986 to be the worst-case year of meteorological data for the annual air quality impacts. The other three emissions scenarios were run in the ISCST model using the same assumptions as discussed above except the analyses were run for only 1984 and 1986 meteorological data.

This screening analysis approach was determined to be acceptable by FDER (Rogers, 1989b). The modeling analysis discussed briefly above is addressed in greater detail below under the results of the screening (coarse grid) phase of the air quality impact assessment in Section 7.0.

Proposed Source Fugitive Dust Emissions

The proposed CG/CC facility contains three fugitive dust source groups. These source groups include aggregate storage piles, aggregate handling operations, and a slag transfer conveyor. The aggregate material to be stored on the site includes coal, limestone, and slag by-product from the coal gasification plants.

The aggregate storage piles subject to wind erosion included the inactive coal storage pile, the active coal storage pile, the limestone storage pile, the interim slag storage area, and a given slag storage area cell. The locations for these area sources are shown in Figure 6-1. The fugitive dust (TSP) emission rate for each of the aggregate storage piles was computed using the EPA emission factor for wind erosion of active storage piles (U.S. EPA, 1986). The emissions inventory for the aggregate storage pile area sources is presented in Table 6-11.

The aggregate handling operations evaluated in the air quality modeling analysis included coal stackout and reclaim for the active coal pile, limestone stackout and reclaim, slag stackout to the interim storage area, and slag stackout to the by-product storage area. The locations for these area sources are the same as the respective area sources shown in Figure 6-1. The fugitive dust (TSP) emission rate for each of the aggregate handling operations was computed using the EPA emission factor for aggregate handling and storage piles (U.S. EPA, 1988a). The emissions inventory for the aggregate handling operations is presented in Table 6-12.

The preliminary design for the CG/CC facility called for the slag to be transported by truck to the slag storage area over an unpaved haul road. The initial air quality modeling analysis for the proposed source fugitive dust impacts assumed the slag haul road to be a narrow volume line source containing eight individual volume sources based on the guidance contained in U.S. EPA (1987a). The uncontrolled fugitive dust (TSP) emission rate for each of the volume sources was computed using the EPA emission factor for unpaved roads (U.S. EPA, 1988b). The preliminary air quality modeling results indicated violations of the PM NAAQS/FAAQS and Class II PSD increments. Subsequent engineering design changes called for the use of a covered slag transfer conveyor system outfitted with wind

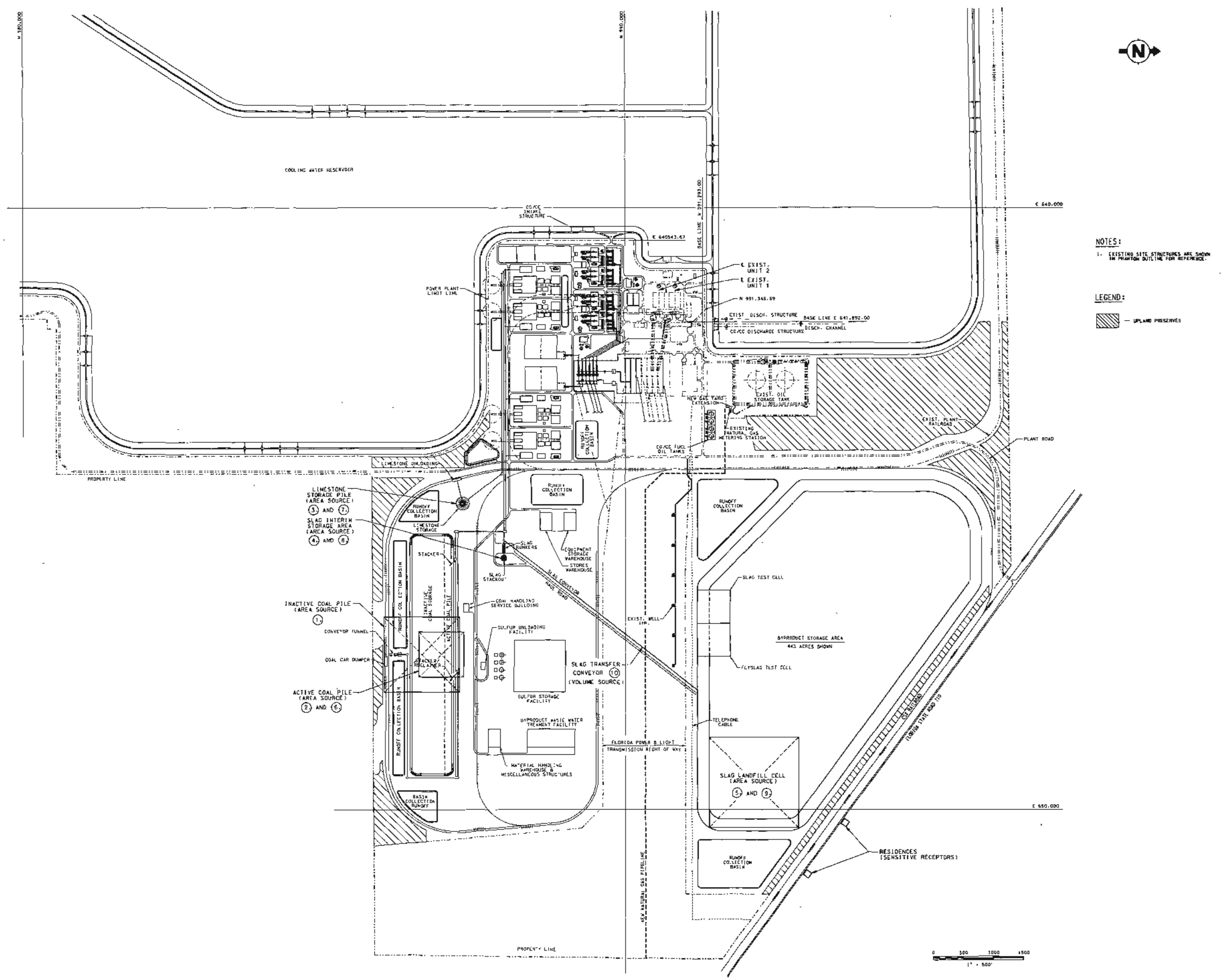


Figure 6–1
FUGITIVE DUST AREA SOURCE LOCATIONS

SOURCE: BECHTEL POWER CORPORATION, 1989

FPL

Martin CG/CC Project

Table 6-11. FPL Martin CG/CC Aggregate Storage Pile Fugitive Dust Emission Parameters

Source ID No.	Fugitive Dust Area Source Description	Emission Rate[(1)] ($g/m^2/sec$)	UTM Coordinates (km) For SW Corner of Area Source		Area Source Height[(2)] (m)	Area Source Width (m)
			East	North		
1a.	Inactive Coal Storage Pile	6.92×10^{-6}	544.73	2991.43	10.7	192.8
1b.		6.92×10^{-6}	544.73	2991.62	10.7	192.8
1c.		6.92×10^{-6}	544.92	2991.62	10.7	192.8
1d.		6.92×10^{-6}	544.92	2991.43	10.7	192.8
2a.	Active Coal Storage Pile	1.73×10^{-5}	544.80	2991.60	10.7	116.9
2b.		1.73×10^{-5}	544.80	2991.72	10.7	116.9
2c.		1.73×10^{-5}	544.92	2991.72	10.7	116.9
2d.		1.73×10^{-5}	544.92	2991.60	10.7	116.9
3.	Limestone Storage Pile	5.67×10^{-6}	544.11	2991.79	18.3	59.4
4.	Slag Interim Storage Area	6.97×10^{-5}	544.41	2992.02	12.2	33.7
5a.	Slag Storage Area Cell	6.94×10^{-6}	545.34	2993.09	18.3	225.0
5b.		6.94×10^{-6}	545.34	2993.32	18.3	225.0
5c.		6.94×10^{-6}	545.57	2993.32	18.3	225.0
5d.		6.94×10^{-6}	545.57	2993.09	18.3	225.0

(1) Based on AP-42 emission factor (U.S. EPA, 1986). A 60% control efficiency was assumed for the inactive coal storage pile and a 90% control efficiency was assumed for the slag storage area cell.

(2) Based on preliminary design data.

Sources: U.S. EPA, 1986.
U.S. EPA, 1987a.

Table 6-12. FPL Martin CG/CC Aggregate Handling Operations Fugitive Dust Emission Parameters

Source ID No.	Fugitive Dust Area Source Description	Emission Rate[1] ($g/m^2/sec$)	UTM Coordinates (km) For SW Corner of Area Source East	North	Area Source Height[2] (m)	Area Source Width (m)
6a.	Coal Stackout and Reclaim for Active Coal Pile	3.83×10^{-6}	544.80	2991.60	15.2	116.9
6b.		3.83×10^{-6}	544.80	2991.72	15.2	116.9
6c.		3.83×10^{-6}	544.92	2991.72	15.2	116.9
6d.		3.83×10^{-6}	544.92	2991.60	15.2	116.9
7.	Limestone Stackout and Reclaim	1.68×10^{-6}	544.11	2991.79	21.3	59.4
8.	Slag Stackout to Interim Storage Area	1.30×10^{-6}	544.41	2992.02	12.2	33.7
9a.	Slag Stackout to By-product Storage Area	7.0×10^{-9}	545.34	2993.09	19.8	225.0
9b.		7.0×10^{-9}	545.34	2993.32	19.8	225.0
9c.		7.0×10^{-9}	545.57	2993.32	19.8	225.0
9d.		7.0×10^{-9}	545.57	2993.09	19.8	225.0

(1) Based on AP-42 emission factor (U.S. EPA, 1988a).

(2) Based on preliminary design data.

Sources: U.S. EPA, 1987a.
U.S. EPA, 1988a.

skirts to provide the required fugitive dust emissions control for this source. The proposed source emissions inventory for this volume line source is presented in Table 6-13 and reflects a 95% control efficiency justified by the use of the covered conveyor system. The air quality modeling results for this source group are conservative since a ground level (1-meter) source height was assumed. (The typical height of the slag transfer conveyor system is expected to be greater than one meter, which would result in lower predicted impacts.)

Fugitive dust emissions for all three source groups discussed above were assumed to be based on TSP in order to be consistent with the PM emissions for the point (stack) source emissions inventory and PSD increments. The fugitive dust emissions for these source groups were assumed to be controlled at specific control efficiencies wherever appropriate control technology could be justified. In all other cases, fugitive dust emissions for the proposed facility were assumed to be uncontrolled in order to assess the worst-case fugitive dust emissions scenario. The fugitive dust sources were parameterized for input to the ISCST model based on guidance contained in U.S. EPA (1987a). The details of the proposed source fugitive dust emissions calculations are provided in Appendix 10.5.6.6.

<u>Existing Background Sources</u>

The results of the proposed source significant impact area analysis (which will be described in Section 7.0) indicated that the proposed facility's air quality impacts could be above the significant impact levels for SO_2, PM, and NO_2 at distances of 50 km, 9.5 km, and at 7.5 km, respectively, from the Martin

Table 6-13. FPL Martin CG/CC Slag Transfer Conveyor System Volume Source Fugitive Dust Emission Parameters

Source ID No.	Fugitive Dust Volume Source Description	Emission Rate[1] (g/sec)	UTM Coordinates For Volume Source Center Point (km) East	North	Volume Source Parameters $H^{(2)}$ (m)	$\sigma_{Zo}^{(3)}$ (m)	$\sigma_{Yo}^{(4)}$ (m)
10a.	Slag Transfer Conveyor Volume Sources	0.17	544.55	2992.17	1.0	0.5	70.9
10b.		0.17	544.64	2992.29	1.0	0.5	70.9
10c.		0.17	544.73	2992.41	1.0	0.5	70.9
10d.		0.17	544.82	2992.53	1.0	0.5	70.9
10e.		0.17	544.91	2992.65	1.0	0.5	70.9
10f.		0.17	545.01	2992.77	1.0	0.5	70.9
10g.		0.17	545.11	2992.89	1.0	0.5	70.9
10h.		0.17	545.20	2993.01	1.0	0.5	70.9

(1) Based on AP-42 emission factor (U.S. EPA, 1988b). A 95% control efficiency was assumed in the emission rate calculations based on the use of a hooded conveyor system fitted with wind skirts to transfer the slag from the interim stackout area to the storage area cell.

(2) Height of the center of the volume source above the ground based on preliminary design data.

(3) $\sigma_{Zo} = \frac{H}{2.15} = \frac{1.0 \text{ m}}{2.15} = 0.5$ meters. Where σ_{zo} is the initial vertical dimension.

(4) $\sigma_{Yo} = \frac{152.4 \text{ m}}{2.15} = 70.9$ meters. Where σ_{yo} is the initial lateral dimension and 152.4 meters is the separation distance for the volume sources.

Sources: U.S. EPA, 1987a.
U.S. EPA, 1988b.

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Site. Therefore, the background source emission inventories for these pollutants were prepared from available databases considering these distances.

The FDER provided computer printouts of the emissions inventories for facilities located within approximately a 50 km radius of the proposed source location (UTM coordinates: East 543.05 km, North 2992.43 km). This information was supplemented with data from air quality permits, PSD permit applications and previous air quality modeling analyses. The SO_2, PM, and NO_2 sources located within 50 km of the Martin Site were identified.

A background source screening procedure was applied such that sources emitting greater than 25 tons/year of an applicable pollutant and located within 15 km of the Martin Site and sources emitting greater than 100 tons/year and located between 15 to 50 km from the Martin Site were included in the ambient air quality standard and PSD increment impact analysis. Sources in the latter category were subject to further screening to determine the potential for significant interaction with the proposed source.

The screening technique applied to sources located between 15 to 50 km from the Martin Site was the "Screening Threshold" method (North Carolina DNR, 1985) developed by the North Carolina Department of Natural Resources and Community Development, and approved for use in PSD modeling analyses by EPA and FDER. The method is designed to objectively eliminate from the emission inventory those sources which are not likely to have a significant interaction with the source undergoing evaluation. In general, sources that should be considered in the modeling analyses are those with emissions greater than Q (in tons/year), which is calculated by the following equation:

$$Q = 20 \times D$$

where: D = the distance in kilometers from the particular source to the source undergoing evaluation.

Those sources with maximum allowable emissions below the calculated "screening threshold" were eliminated from consideration in the modeling analysis unless the source was a PSD increment consuming source, in which case it was retained in the emission inventory for further evaluation in the refined modeling analysis. The remaining sources not screened out, along with all sources greater than 25 tons/year emissions of a given applicable pollutant and located within 15 km of the Martin Site, comprised the background source emission inventory to be used in the modeling analysis.

The resulting background source emission inventories for SO_2, PM and NO_2 were sorted with respect to PSD increment consuming sources and baseline sources. In general, the PSD regulations define PSD sources as those sources which commenced construction after the baseline date for a specified pollutant. Baseline sources are defined as those sources which commenced construction prior to the baseline date for a specified pollutant. In a discussion with FDER (Rogers, 1989a), it was indicated that the PSD baseline date for major sources (greater than 100 tons/year) of SO_2 and PM is January 6, 1975, and the minor source (less than 100 tons/year) PSD baseline date for these pollutants is December 27, 1977. In regard to NO_2, the baseline date for both major and minor sources is February 8,1988. The existing FPL Martin Plant Units 1 and 2 and existing FPL Riviera Plant Units 2, 3 and 4 are baseline sources for SO_2, PM and NO_2 because they commenced construction prior to January 6, 1975 and February 8, 1988, respectively.

The background PSD source and baseline source emission inventories were based on stack co-location wherever possible. Multiple-stack background facility emissions were combined and assumed to be emitted from the stack with the highest emission rate using that stack's emission parameters (e.g., stack height, stack exit temperature, stack exit velocity and stack exit diameter).

The completed background source emissions inventory was submitted to FDER for review and was determined to be acceptable for input to the ISCST model (Rogers, 1989d). The background PSD source and baseline source emissions inventories used in the air quality modeling analysis are presented in Tables 6-14 and 6-15, respectively. The emissions for all applicable pollutants in those tables are in terms of maximum allowable emissions in order to evaluate a worst-case emissions scenario for those sources from both an ambient standard and PSD increment impact standpoint. The locations for all of the background sources and the proposed source are shown in Figure 6-2.

6.5 Receptor Locations

The general modeling approach discussed above considered screening and refined phases of the modeling analysis to assess air quality impacts on the applicable ambient air quality standards and PSD increments. The ISCST modeling analysis was composed of a proposed source significant impact area analysis, a background source interaction screening analysis, a coarse grid (screening) modeling analysis for the proposed source, a fugitive dust impact screening analysis, and a fine grid (refined) modeling analysis for the proposed and background

Table 6-14. Background Source Emissions Inventory - PSD Sources.

Source ID No. & ID	UTM Coordinates (km) East	UTM Coordinates (km) North	Stack Parameters[1] H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	Maximum Allowable Emission Rates (grams/sec.) SO_2	PM	NO_2	Distance from Martin Site (km)
1 - Power Ventures	569.4	2975.9	19.2	422	22.6	0.9	6.8	(2)	88.1	31.3
2 - Fort Pierce Utilities	566.8	3036.3	45.7	408	12.5	2.4	77.9	(2)	(2)	49.5
3 - U.S. Sugar Corp.	506.1	2956.9	45.7	340	25.2	2.2	85.7	14.7	(2)	51.6
4 - Atlantic Sugar Assoc.	552.9	2945.2	27.4	339	9.7	2.0	11.8	4.8	(2)	48.7
5 - Osceola Farms	544.2	2968.0	27.4	341	16.9	1.9	33.4	7.2	(2)	24.9
6 - Sugar Cane Growers Co-op	534.9	2953.3	47.2	344	10.6	3.0	71.2	12.0	15.5	40.4
7 - U.S. Sugar - Bryant Plant	538.8	2968.1	30.5	344	22.4	2.1	32.5	11.0	17.5	25.1
8 - Pratt and Whitney	558.1	2979.1	4.6	644	13.4	3.4	23.4	(2)	(2)	20.4
9 - Palm Beach RR Facility	585.8	2960.2	76.2	505	24.9	2.0	44.1	(2)	(2)	53.8

(1) Stack height (H_s), stack exit temperature (T_s), stack exit velocity (V_s) and stack exit diameter (D_s).

(2) No emissions data available from FDER for these sources and air pollutants.

Source: Rogers, 1989d

Table 6-15. Background Source Emissions Inventory - Baseline Sources

Source ID No. & ID	UTM Coordinates (km) East	UTM Coordinates (km) North	Stack Parameters[1] H_s (m)	T_s (°K)	V_s (m/sec)	D_s (m)	Maximum Allowable Emission Rates (grams/sec.) SO_2	PM	NO_2	Distance from Martin Site (km)
10 - FPL - Martin Units 1 & 2	543.05	2992.86	152.1	421	21.1	8.0	1743.8	218.0	654.0	0.4
11 - Everglades Sugar	509.6	2954.2	21.9	477	10.1	1.1	40.5	(2)	(2)	51.1
3 - U.S. Sugar Corp.	506.1	2956.9	22.9	344	25.3	1.9	68.3	51.6	(2)	51.6
4 - Atlantic Sugar Assoc.	552.9	2945.2	27.4	342	13.0	1.9	30.9	32.8	(2)	48.7
5 - Osceola Farms	544.2	2968.0	27.4	341	23.6	1.9	56.4	30.1	(2)	24.9
6 - Sugar Cane Growers Co-op	534.9	2953.3	24.4	336	14.4	1.6	51.6	52.8	17.1	40.4
7 - U.S. Sugar - Bryant Plant	538.8	2968.1	19.8	342	36.4	1.6	35.5	47.0	(2)	25.1
12 - Pratt and Whitney	559.2	2978.3	15.2	533	40.2	0.9	74.0	(2)	60.5	21.7
13 - FPL Riviera Plant	594.2	2960.6	90.8	408	18.9	4.9	2238.5	(2)	454.6	60.3
14 - Caulkins Citrus Co.	548.1	2991.5	28.7	343	11.9	1.0	(2)	3.5	(2)	5.2

(1) Stack height (H_s), stack exit temperature (T_s), stack exit velocity (V_s) and stack exit diameter (D_s).

(2) No emissions data avialable from FDER for these sources and air pollutants.

Source: Rogers, 1989d

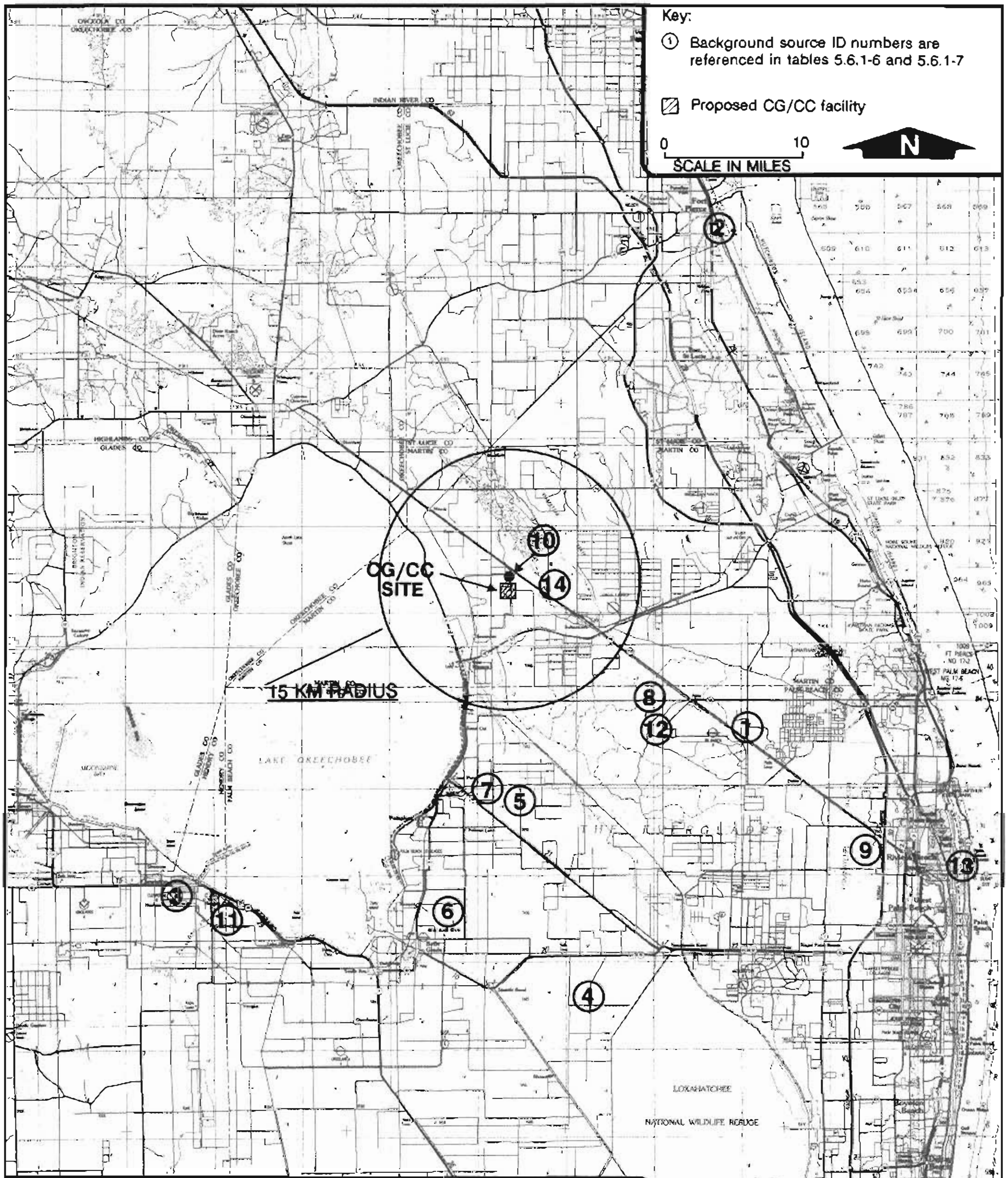

Figure 6-2
PROPOSED MARTIN CG/CC FACILITY AND BACKGROUND AIR POLLUTANT EMISSION SOURCES LOCATIONS

Source: Envirosphere Company, 1989

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sources. A description of the receptor grids used in each of these modeling analyses is presented below.

Receptor Grid for Proposed Source Significant Impact Area Analysis

This modeling analysis used a receptor grid consisting of a cartesian grid section beginning at the plant property boundary line and extending out to effectively cover a 10 km square area centered over the proposed source and having a 0.5 km grid resolution. The cartesian receptor grid section was combined with a polar grid section consisting of 36 radials, each separated by 10-degree increments and extending outward at ring distances of 6.5, 8.5, 10.5, 12.5, 15.0, 20.0, 25.0, 30.0, 40.0, and 50.0 km with reference to the proposed source location. This receptor grid consisted of a total of 673 receptors and is shown (out to the 15 km ring only) in Figure 6-3.

Receptor Grid Background Source Interaction Screening Analysis

This modeling analysis used a polar receptor grid consisting of 24 radials ranging in direction from 10 degrees to 240 degrees in 10-degree increments and extending outward at ring distances of 10.0, 15.0, 17.5, 20.0, 22.5, 25.0, 30.0, 35.0, 40.0, and 45.0 km with reference to the proposed source location. No radials were included in the northwest quadrant due to the lack of existing sources in that direction. This receptor grid consisted of 240 receptors and is shown in Figure 6-4.

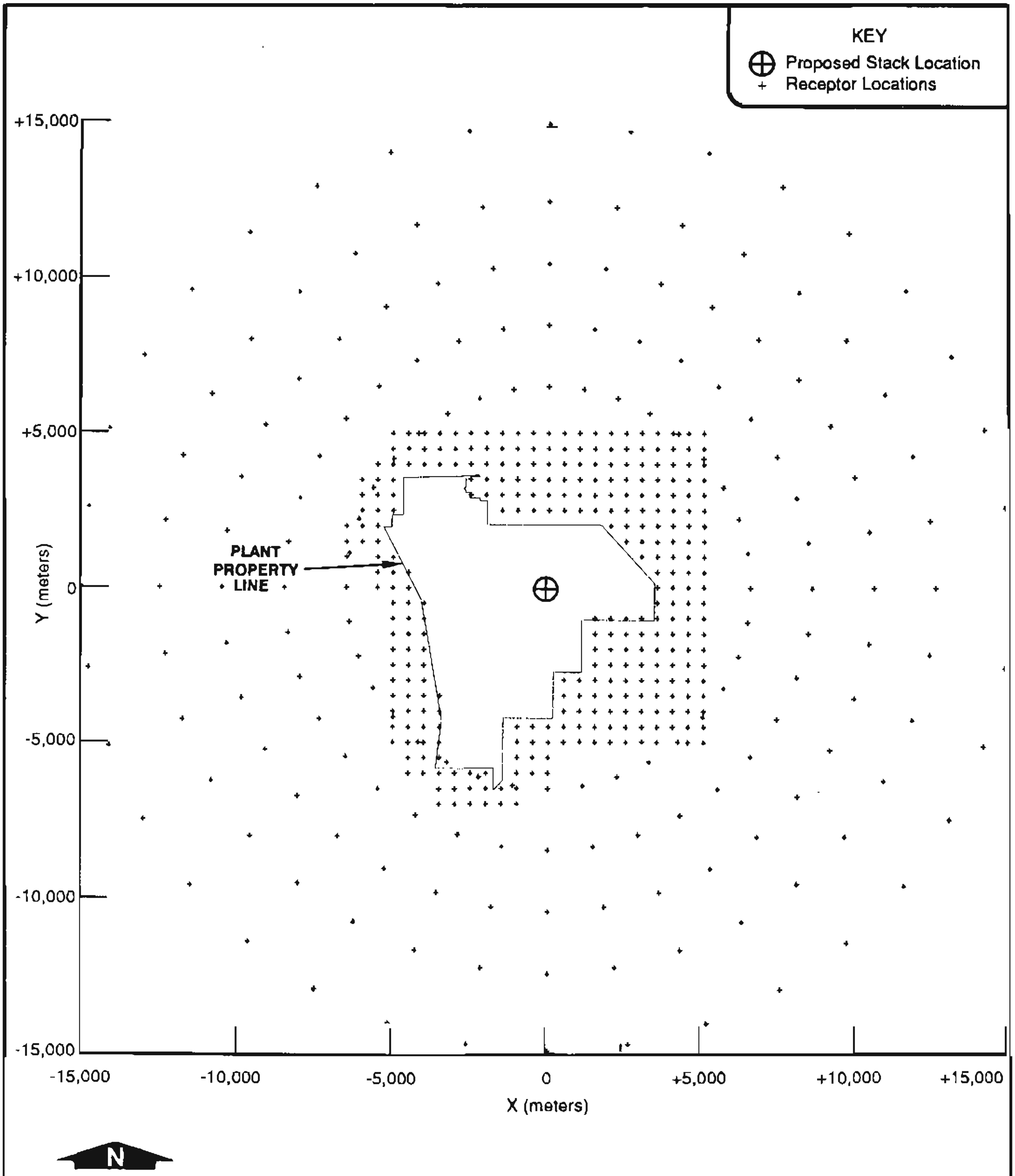

Figure 6-3
RECEPTOR GRID FOR PROPOSED SOURCE MODELING ANALYSIS

Source: Envirosphere Company, 1989

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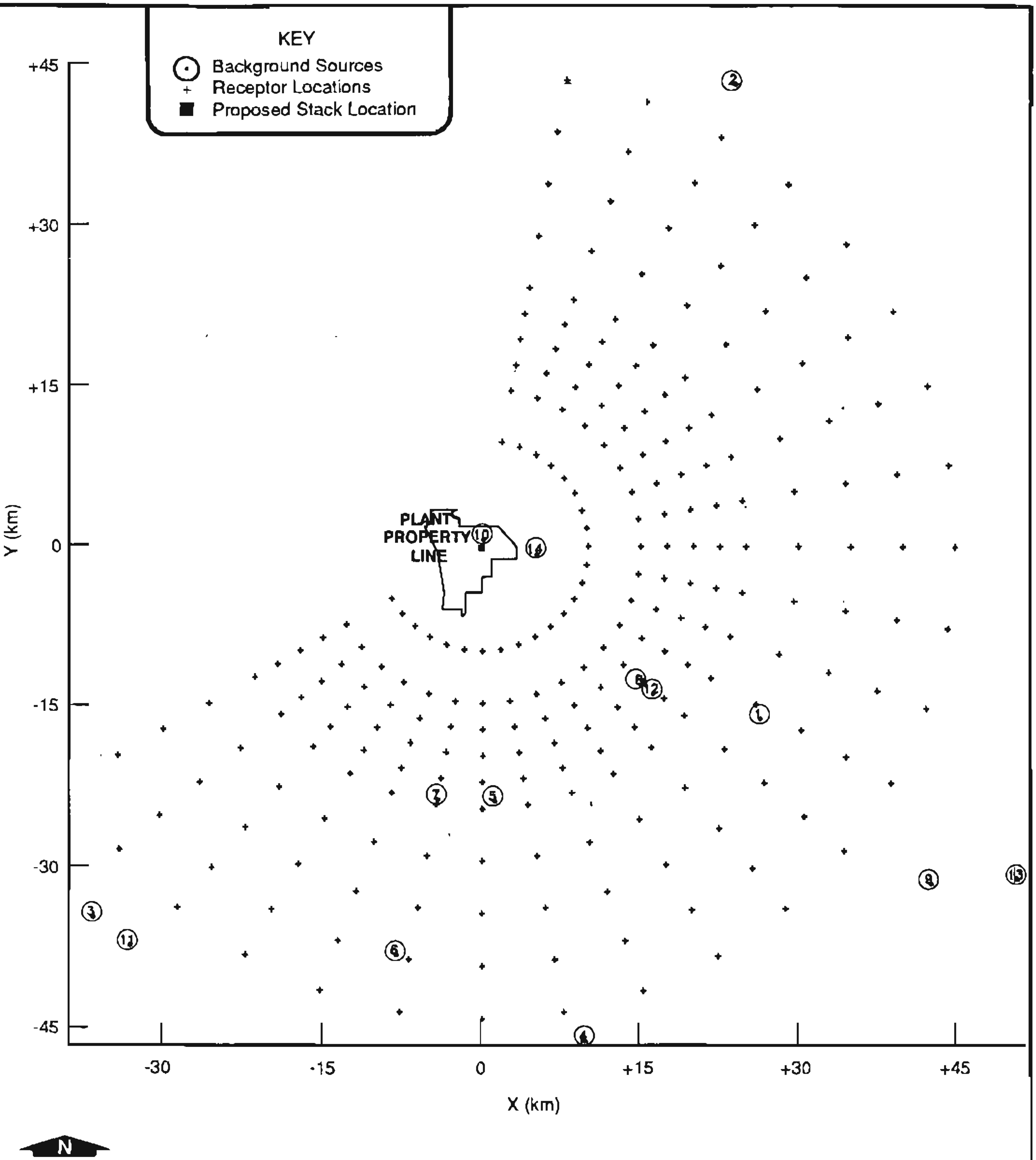

Figure 6-4
RECEPTOR GRID FOR BACKGROUND SOURCE INTERACTION SCREENING ANALYSIS

Source: Envirosphere Company, 1989

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Coarse Grid for Screening Phase Modeling Analysis For The Proposed Source

This modeling analysis used the same basic receptor grid as the grid described above for the proposed source significant impact area analysis except that the polar grid section of the receptor grid was limited to ring distances of 6.5, 8.5, 10.5, 12.5, and 15.0 km. This receptor grid was designed to focus on the proposed source air quality impact locations in order to determine critical receptors for the refined phase modeling analysis. This receptor grid consisted of 493 receptors and is shown in Figure 6-3.

Receptor Grid for Fugitive Dust Impact Screening Analysis for the Proposed Source

This modeling analysis used the same receptor grid as the grid used in the coarse grid (screening phase) modeling analysis described above. Refer to Figure 6-3 for details.

Fine Grid for Refined Phase Modeling Analysis

In accordance with guidance provided by FDER (Rogers, 1989b), the results of the coarse grid modeling analysis for the proposed source were used to identify critical receptors associated with the highest and highest second-highest short-term concentrations for all applicable pollutants and averaging times which were evaluated further in greater detail in the refined (fine grid) phase of the modeling analysis.

This modeling analysis used a cartesian receptor grid covering roughly a 1.0 km square area centered over each critical receptor identified in the proposed source coarse grid (screening phase) modeling analysis. This receptor grid had a grid resolution of 0.1 km and consisted of up to 121 receptors, depending upon the location of the plant property boundary line with respect to the critical receptor location.

6.6 Background Concentrations

The background concentrations for SO_2, PM, and NO_2 were determined according to the procedure documented at Section 9.2.3 in U.S. EPA (1987). This procedure calls for a determination of a modeled background concentration component and an ambient air quality monitoring data-derived background concentration component. The modeled background concentration component was derived from the modeled impact for all applicable background sources identified above at the critical receptors. This background concentration component is addressed below in the summary of the refined (fine grid) phase modeling analysis results in Section 7.0.

The ambient air quality monitoring data-derived background concentration component was based on ambient air quality monitoring data from the on-site PSD monitoring program discussed and summarized in Section 5.0. The highest monitored concentration for each applicable criteria air pollutant and averaging time was selected based on the nine months of on-site monitoring data summarized in Table 5-4 in Section 5.0.

The total background concentrations for SO_2, PM, and NO_2 were determined by modeling all applicable background sources at appropriate critical receptors and adding to that modeled impact, the highest monitored concentration as discussed above.

This conservative approach was approved by the FDER (Rogers, 1989b). The total background concentrations are summarized under the results of the refined (fine grid) modeling analysis in Section 7.0.

7.0 AIR QUALITY IMPACT ANALYSIS RESULTS

The main objective of the air quality modeling analysis was to demonstrate that the Class I and II PSD increments and applicable ambient air quality standards will be met during the operation of the proposed facility. Impacts of the new facility's noncriteria pollutant emissions are also predicted.

The proposed source was initially modeled using preliminary design emissions data. Subsequent refinements to the proposed source engineering design called for further revisions to the proposed source emissions inventory which affected only the pollutant emissions levels for the coal-derived gas scenario. Hence, the initial modeling results for the proposed source air quality impacts were scaled using the revised proposed source worst-case emissions data presented in Tables 6-2 through 6-6.

7.1 PROPOSED SOURCE SCREENING (COARSE GRID) PHASE MODELING ANALYSIS

The five emissions scenarios that represent the range of operating modes for the proposed source (based upon the use of natural gas, No. 2 distillate fuel oil, and coal-derived gas) were described in Section 6.0. A screening modeling analysis was performed using the ISCST model, five years of meteorological data, the coarse receptor grid described previously and shown in Figure 6-3, and the five proposed source SO_2 emissions scenarios presented in Tables 6-2 through 6-6.

The two scenarios having maximum emission rates for most pollutants, No. 2 oil at 40°F and coal-derived gas at 75°F, were modeled using all five years of meteorological data (1982-1986). For each of these scenarios, maximum annual impacts occurred in 1986 and highest second-highest short-term impacts occurred in 1984. Therefore, in an effort to insure that maximum impacts for each pollutant were identified, the other three scenarios (natural gas at 40°F and 95°F and No. 2 oil at 95°F) were modeled for 1986 annual average impact and 1984 short-term impacts.

The results of this coarse-grid modeling analysis are presented in Tables 7-1 through 7-5. Highest and highest second-highest 3-hour and 24-hour impacts and highest annual average impacts are tabulated for each of the five criteria pollutants subject to air quality modeling analysis. Note that these averaging periods are not applicable for all pollutants, in terms of standards and increments, but are presented for information only. Since not all of the maximum impacts occur under the same scenario (even for a single pollutant), the worst-case maxima for the five scenarios are summarized in Table 7-6. Impacts for the noncriteria pollutants, which were determined in identical fashion, also appear in Table 7-6. A supplemental table, Table 7-7, presents the 1-hour and 8-hour impacts which are applicable for CO.

The results of the coarse grid (screening phase) modeling analysis for the proposed source emissions scenario were used to select critical receptors and critical days of meteorological data for further analysis in the refined (fine grid) phase modeling analysis. The highest annual average concentration for SO_2 and the highest and highest second-highest short-term concentrations for SO_2 were selected from Table 7-6 as critical air quality impacts. The highest short-term impacts were also included in the refined modeling analysis at the request of FDER. The critical receptors and critical days associated with these impacts are summarized in Table 7-8. All three of the critical impacts occur under the

Table 7-1. Predicted Air Impact Concentrations - Coarse-Grid Modeling

Natural Gas, 40°F

	1984 Meteorology				1986
	Three-Hour		24-Hour		Annual
	High	High 2nd High	High	High 2nd High	High
Model Emissions (g/sec)	105.6	105.6	105.6	105.6	105.6
Model Impact ($\mu g/m^3$)	26.72	24.83	7.619	6.777	0.695
Impact/Emission ($\mu sec/m^3$)	0.2531	0.2351	0.07215	0.06418	0.006582
Modeled Impacts ($\mu g/m^3$)					
SO_2	26.7	24.8	7.6	6.8	0.70
PM	4.8	4.5	1.4	1.2	0.13
NO_2	76.1	70.7	21.7	19.3	1.98
CO	40.7	37.8	11.6	10.3	1.06
Pb	0	0	0	0	0
Time and Place of Impact					
Year	1984	1984	1984	1984	1986
Julian Day	123	200	200	123	
X-coordinate (m)	-1000	-1000	-1000	-1000	-4500
Y-coordinate (m)	+2500	+2500	+3000	+3000	0

Table 7-2. Predicted Air Impact Concentrations - Coarse-Grid Modeling

Natural Gas, 95°F

	1984 Meteorology				1986 Annual
	Three-Hour		24-Hour		
	High	High 2nd High	High	High 2nd High	High
Model Emissions (g/sec)	93.6	93.6	93.6	93.6	93.6
Model Impact ($\mu g/m^3$)	28.96	24.75	7.508	6.674	0.6927
Impact/Emission ($\mu sec/m^3$)	0.3094	0.2644	0.0802	0.0713	0.00740
Modeled Impacts ($\mu g/m^3$)					
SO_2	28.9	24.7	7.5	6.7	0.69
PM	5.5	4.7	1.4	1.3	0.13
NO_2	79.0	67.5	20.5	18.2	1.89
CO	42.9	36.6	11.1	9.9	1.03
Pb	0	0	0	0	0
Time and Place of Impact					
Year	1984	1984	1984	1984	1986
Julian Day	12	200	200	123	
X-coordinate (m)	+2500	-1000	-1000	-1000	-4500
Y-coordinate (m)	-3000	+2500	+3000	+3000	0

Table 7-3. Predicted Air Impact Concentrations - Coarse-Grid Modeling

No. 2 Oil, 40°F

	1982-1986 Meteorology				
	Three-Hour		24-Hour		Annual
	High	High 2nd High	High	High 2nd High	High
Model Emissions (g/sec)	940.8	940.8	940.8	940.8	940.8
Model Impact ($\mu g/m^3$)	235.4	218.8	68.94	59.8	6.131
Impact/Emission ($\mu sec/m^3$)	0.2502	0.2325	0.0733	0.0636	0.00652
Modeled Impacts ($\mu g/m^3$)					
SO_2	235.4	218.7	68.9	59.8	6.13
PM	15.5	14.4	4.5	3.9	0.40
NO_2	118.9	110.5	34.8	30.2	3.10
CO	41.1	38.2	12.0	10.4	1.07
Pb	0.0043	0.0040	0.0013	0.0011	0.0001
Time and Place of Impact					
Year	1983	1984	1984	1984	1986
Julian Day	20	123	123	200	
X-coordinate (m)	-5000	-1000	-1000	-1000	-4500
Y-coordinate (m)	-1000	+3000	+2500	+2500	0

Table 7-4. Predicted Air Impact Concentrations - Coarse-Grid Modeling

No. 2 Oil, 95°F

	1984 Meteorology				1986
	Three-Hour		24-Hour		Annual
	High	High 2nd High	High	High 2nd High	High
Model Emissions (g/sec)	820	820	820	820	820
Model Impact ($\mu g/m^3$)	253.6	214.4	65.10	57.86	6.000
Impact/Emission ($\mu sec/m^3$)	0.3093	0.2615	0.0794	0.0706	0.00732
Modeled Impacts ($\mu g/m^3$)					
SO_2	253.6	214.3	65.1	57.9	6.00
PM	17.4	14.7	4.5	4.0	0.41
NO_2	125.5	106.1	32.2	28.6	2.97
CO	43.1	36.4	11.1	9.8	1.02
Pb	0.0050	0.0042	0.0013	0.0011	0.0001
Time and Place of Impact					
Year	1984	1984	1984	1984	1986
Julian Day	12	200	200	123	
X-coordinate (m)	+2500	-1000	-1000	-1000	-4500
Y-coordinate (m)	+3000	+2500	+3000	+3000	0

Table 7-5. Predicted Air Impact Concentrations - Coarse-Grid Modeling

Coal Gas, 75°F

	1982-1986 Meteorology				
	Three-Hour		24-Hour		Annual
	High	High 2nd High	High	High 2nd High	High
Model Emissions (g/sec)	1088	1088	1088	1088	1088
Model Impact ($\mu g/m^3$)	289.5	270.4	85.2	72.83	7.500
Impact/Emission ($\mu sec/m^3$)	0.2661	0.2485	0.0783	0.0669	0.00689
Modeled Impacts ($\mu g/m^3$)					
SO_2	231.5	216.2	68.1	58.2	6.00
PM	5.3	5.0	1.6	1.3	0.14
NO_2	116.2	108.5	34.2	29.2	3.01
CO	55.0	51.3	16.2	13.8	1.42
Pb	0.087	0.081	0.026	0.022	0.002
Time and Place of Impact					
Year	1985	1984	1985	1984	1986
Julian Day	284	200	284	123	
X-coordinate (m)	-1000	-1000	-1000	-1000	-4500
Y-coordinate (m)	+3000	+2500	+3000	+3000	0

Table 7-6. Predicted Air Impact Concentrations - Coarse-Grid Modeling[1]

(Worst Case Among All Five Scenarios)

Modeled Impacts (ug/m3)

	Three-Hour		24-Hour		Annual
	High	High 2nd High	High	High 2nd High	High
SO_2	253.6	218.7	68.9	59.8	6.13
PM	17.4	14.7	4.5	4.0	0.41
NO_2	125.5	110.5	34.8	30.2	3.10
CO	55.0	51.3	16.2	13.8	1.42
Pb	0.087	0.081	0.026	0.022	0.0023
Be	0.0053	0.0045	0.0014	0.0012	0.00013
Hg	0.0075	0.0070	0.0022	0.0019	0.00019
As	0.0047	0.0044	0.0014	0.0012	0.00012

(1) Worst case impacts presented are summarized from Tables 7-1 through 7-5 the maximum impacts due to coarse grid modeling of the five operating scenarios examined.

Table 7-7. Predicted Air Impact Concentrations - Coarse Grid Modeling (Supplementary Averaging Periods for CO)

Modeled Impacts ($\mu g/m^3$)

	One-Hour		Eight-Hour		
	High	High 2nd High	High	High 2nd High	
$CO^{(1)}$		110.5	91.5	36.0	33.8

Time and Place of Impact				
Year	1985	1984	1985	1984
Julian Day	277	112	284	123
X-coordinate (m)	-1000	-1500	-1000	-1000
Y-coordinate (m)	2500	2500	3000	3000

(1) Maximum CO impacts occur under the coal gas at 75°F scenario.

Table 7-8. Summary of Coarse Grid Critical Receptors and Critical Days for SO_2

Averaging Period		Scenario	Critical Year (Julian Day)	Critical Receptor X	Y
3-Hour	Highest	No. 2 oil, 95°F	1984 (12)	+2500	-3000
	High 2nd-High	No. 2 oil, 40°F	1984 (200)	-1000	+2500
24-Hour	Highest	No. 2 oil 40°F	1983 (20)	-5000	-1000
	High 2nd-High	No. 2 oil 40°F	1984 (123)	-1000	+3000
Annual	Highest	No. 2 oil, 40°F	1986	-4500	0

Envirosphere, 1989c.

No. 2 oil at 40°F scenario, which was therefore treated as the worst case for refined modeling.

7.2 PROPOSED SOURCE SIGNIFICANT IMPACT AREA ANALYSIS

The purpose of the significant impact area analysis was two-fold. First, SO_2, PM, NO_2 and CO emissions for the proposed facility based on the worst-case emissions scenario were modeled in the screening (coarse grid) phase of the modeling analysis to determine the maximum annual and second-highest short-term impacts for each applicable pollutant to be compared to the appropriate significant impact levels. The EPA air quality impact assessment guidelines for PSD (U.S. EPA, 1980b) indicate that if preliminary dispersion modeling demonstrates that proposed emissions of a criteria pollutant will have no significant impacts, further air quality impact analysis of that pollutant will generally not be required, unless the source is located near a PSD Class I area.

The second purpose of this analysis was to define for those pollutants with impacts greater than the significant impact levels a distance at which all concentrations due to the proposed source are less than significant. Once this distance is determined for each pollutant, only those sources within this defined significant impact area and those sources located outside the significant impact area and having the potential to interact with the proposed source need to be modeled to determine the air quality impacts due to proposed and background source interaction.

The results of the proposed source significant impact area analysis are presented in Table 7-9. The CO impacts from Table 7-7 are well below the levels considered significant. Thus, there is no off-site CO significant impact area, and no further

Table 7-9. Summary of Proposed Source Significant Impact Area Analysis

Pollutant	Averaging Time	Coarse-Grid Screening Phase Impact ($\mu g/m^3$)	Significant Impact Levels ($\mu g/m^3$)	Proposed Source Significant Impact Area (km)[1]
SO_2	Annual	6.1	1	>50 (1.6 $\mu g/m^3$)[2]
	24-Hour	59.8	5	>50 (14.2 $\mu g/m^3$)[2]
	3-Hour	218.7	25	>50 (49.2 $\mu g/m^3$)[2]
PM (TSP)	Annual	13.3[3]	1	7.2
	24-Hour	28.8[3]	5	9.5
NO_2	Annual	3.1	1	7.5
CO	8-Hour	33.8	500	None Offsite
	1-Hour	91.5	2000	None Offsite

(1) Significant impact area determinations were based on maximum annual impacts and highest second-highest short-term impacts (Rogers, 1989b).

(2) The SO_2 impacts for all applicable averaging times exceed the significant impact levels at the 50 km distance as indicated by the values in parenthesis.

(3) Fugitive source emissions were critical for determination of impact areas for TSP.

Source: U.S. EPA, 1980

air quality impact analysis is required for CO. Likewise, the impacts due to the proposed source PM stack emissions are insignificant. However, the fugitive source particulate emissions are predicted to have significant off-site impacts (as is demonstrated later in this Section). The impact areas designated in Table 7-9 for PM were based on modeling of fugitive emissions.

Table 7-9 indicates that SO_2, NO_2 and PM (TSP) need to be analyzed further in the refined phase of the air quality impact assessment. The refined modeling analysis for the proposed source and existing background sources was limited to a distance of 50 km from the Martin Site because the U.S. EPA Guideline on Air Quality Models (U.S. EPA, 1987) indicates that the maximum distance for refined Gaussian dispersion model application for regulatory purposes is generally considered to be 50 km. Beyond the 50 km range, screening techniques may be used to determine if more refined modeling is needed. The proposed source SO_2 impacts for all applicable averaging times at a 50 km distance shown in Table 7-9 are not considered to pose a threat to ambient air quality standards or PSD Class II increments. Hence, more refined modeling analysis of the proposed source impacts beyond 50 km is not justified.

7.3 BACKGROUND SOURCE INTERACTION SCREENING ANALYSIS

In response to FDER concerns regarding the extent to which background sources interact among themselves and with the proposed source, a screening analysis for the proposed and background sources' impacts was performed to justify using the proposed source coarse grid modeling results to select critical receptors for further analysis in the refined phase modeling analysis. This screening analysis was performed using the ISCST model, the receptor grid discussed previously and shown in Figure 6-4, five years of meteorological data as described above, assuming the initial design worst-case proposed source SO_2 emissions scenario of coal-derived gas 100% load at 75°F, 1088.0 g/s compared to the revised design worst-case SO_2 emissions scenario of 940.8 g/s (No. 2 oil, 40°F) and assuming maximum allowable SO_2 emissions for the background sources. The modeling analysis was conservative and was performed for only the 3-hour and 24-hour averaging times which represented the worst-case air quality impact cases based on preliminary modeling results.

The results of the background source interaction screening analysis are summarized in Table 7-10. The results of this analysis indicate that the impacts due to source interaction within 50 km of the Martin Site do not threaten ambient air quality standards. Table 7-11 provides a summary of the critical day impacts and shows that due to the wind directions prevailing at the time of the worst-case impacts, the proposed source does not impact the critical receptors.

Table 7-12 provides a summary of worst-case PSD source impacts at common receptors, but independent of time. The results of that analysis indicate that the PSD source impact resulting from source interaction do not threaten the Class II PSD increments.

The results of this background source interaction screening analysis justify not running the background source emissions inventory in the screening (coarse grid) phase of the modeling analysis. Subsequently, the background source impacts were addressed in the refined (fine grid) phase modeling analysis based upon the proposed source coarse grid modeling analysis results.

Table 7-10. Summary of Background SO_2 Source Interaction Screening Analysis[1]

Averaging Time	Year (Julian Day, Period)	Receptor Grid Coordinates		Total Highest Concentration ($\mu g/m^3$)	Total Second Highest Concentration ($\mu g/m^3$)	Florida Ambient Standard ($\mu g/m^3$)
		Range(km)	Degrees			
3-Hour	1982 (250,7)	25.0	180	347.4	----	1300
	1983 (38,5)	22.5	130	349.8	----	
	1984 (6,4)	40.0	190	*463.9	----	
	1985 (19,6)	40.0	190	349.0	----	
	1986 (359,4)	40.0	190	323.2	----	
	1982 (131,1)	25.0	180	----	344.0	
	1983 (358,6)	40.0	190	----	339.0	
	1984 (28,4)	40.0	190	----	*456.2	
	1985 (82,4)	40.0	190	----	328.0	
	1986 (285,4)	25.0	180	----	307.5	
24-Hour	1982 (301,1)	25.0	180	143.1	----	260
	1983 (131,1)	25.0	180	*148.3	----	
	1984 (305,1)	25.0	180	128.7	----	
	1985 (262,1)	25.0	180	127.6	----	
	1986 (348,1)	25.0	180	126.5	----	
	1982 (124,1)	25.0	180	----	*140.8	
	1983 (302,1)	25.0	180	----	131.6	
	1984 (306,1)	25.0	180	----	124.6	
	1985 (66,1)	25.0	180	----	120.2	
	1986 (314,1)	25.0	180	----	101.9	

(1) Air quality impacts include proposed source impacts based on the initial design worst-case emissions scenario of coal-derived gas 100% load at 75°F ambient temperature (1088.0 g/sec.) compared to the revised proposed source design worst-case emissions scenario of No. 2 fuel oil 100% load at 40°F (940.8 g/sec.).

* Critical air quality impacts for the background source interaction screening analysis.

Table 7-11. Summary of Background Source Interaction Screening Analysis Critical Day Impacts

Averaging Time	Year (Julian Day, Period)	Receptor Grid Coordinates Range(km)	Receptor Grid Coordinates Degrees	Total Highest Concentration (µg/m³)	Proposed Source Contribution (µg/m³)	Total Second Highest Concentration (µg/m³)	Proposed Source Contribution (µg/m³)
3-Hour	1984 (6,4)	40.0	190	463.9	0[1]	----	----
	1984 (28,4)	40.0	190	----	----	456.2	0[2]
24-Hour	1983 (131,1)	25.0	180	148.3	0[3]	----	----
	1982 (124,1)	25.0	180	----	----	140.8	0[4]

1 The wind directions for Julian day 6, period 4 of 1984 were 288°, 285°, and 286°, resulting in no proposed sourced interaction at critical receptor.

2 The wind directions for Julian day 28, period 4 of 1984 were 284°, 284°, and 286°, resulting in no proposed source interaction at critical receptor.

3 The wind directions for Julian day 131 of 1983 ranged from 56° to 96°, resulting in no proposed source interaction at critical receptor.

4 The wind directions for Julian day 124 of 1982 primarily ranged from 51° to 74°, resulting in no proposed source interaction at critical receptor.

Table 7-12. Summary of PSD SO_2 Source Interaction Screening Analysis

Averaging Time	Year	Receptor Grid Coordinates Range(km)	Receptor Grid Coordinates Degrees	Total Highest Concentration[1] ($\mu g/m^3$)	Total Second Highest Concentration[1] ($\mu g/m^3$)	SO_2 Class II PSD Increment ($\mu g/m^3$)
3-Hour	1982	25.0	180	216.1	----	512
	1983	10.0	110	215.5	----	
	1984	40.0	190	180.2	----	
	1985	25.0	180	*217.1	----	
	1986	25.0	180	208.0	----	
	1982	25.0	180	----	*204.6	
	1983	25.0	180	----	198.2	
	1984	40.0	190	----	169.4	
	1985	40.0	190	----	159.1	
	1986	25.0	180	----	181.2	
24-Hour	1982	25.0	180	71.1	----	91
	1983	25.0	180	81.9	----	
	1984	25.0	180	*85.9	----	
	1985	25.0	180	72.2	----	
	1986	10.0	240	65.7	----	
	1982	25.0	180	----	69.0	
	1983	25.0	180	----	*73.8	
	1984	25.0	180	----	71.0	
	1985	25.0	180	----	61.7	
	1986	25.0	180	----	49.8	

[1] Total SO_2 impact for proposed source and background PSD sources at a common receptor independent of time.

* Worst-case air quality impacts for PSD sources in the background source interaction screening analysis.

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7.4 REFINED (FINE GRID) PHASE MODELING ANALYSIS

The refined phase modeling analysis consisted of modeling the proposed source worst-case emissions inventory for stack emissions (Tables 6-4 and 6-5) and fugitive sources (Tables 6-11, 6-12, and 6-13) and the background PSD and baseline source emissions inventories (Tables 6-14 and 6-15) in the ISCST model for the critical receptors and critical days identified in Table 7-8. This modeling analysis was performed using the fine receptor grid described in Section 6.0 to determine the highest second-highest short-term air quality impacts for SO_2 and PM.

To insure that the highest and highest second-highest short-term critical receptors identified in the coarse-grid analysis remain valid for the refined analysis, each critical receptor was re-examined in a refined analysis. Fine receptor grids (100-meter spacing) were centered on each critical receptor, as described in Section 6.0, and refined modeling was done to pinpoint maxima for the worst-case meteorological conditions. The results of this refined analysis, presented in Table 7-13, confirm the time of the occurrence of highest and highest second-highest to be those selected by the coarse-grid analysis.

An impact analysis for the annual averaging time was not performed in the refined modeling analysis since annual average impacts are not expected to change significantly from a coarse receptor grid to a fine receptor grid. Hence, the coarse grid annual average highest impact was assumed to be representative of the highest annual average proposed source impact and the background source emissions impacts were modeled at that critical receptor to obtain the total source annual impact for SO_2, PM, and NO_2.

Table 7-13. Summary of Refined (Fine Grid) Modeling Analysis Results for Proposed Source Short-Term SO_2 Impacts

Averaging Period		Scenario	Critical Year (Julian Day)	Critical Receptor X	Critical Receptor Y	SO_2 Impact ($\mu g/m^3$)
3-Hour	Highest	Oil, 95°F	1984 (12)	+2400	-2600	272.4
	High 2nd-High	Oil, 40°F	1984 (200)	-1000	+2700	252.4
24-Hour	Highest	Oil, 40°F	1983 (20)	-4600	-800	71.9
	High 2nd-High	Oil, 40°F	1984 (123)	-1100	+3000	65.5

Maximum proposed source PM impacts were found to be due to fugitive source emissions, rather than stack emissions, for all operating scenarios and averaging times. The area-source emissions and modeling parameters in Tables 6-11 and 6-12 and the volume source parameters in Table 6-13 were applied to the receptor grid in Figure 6-3, as described in Section 6.0. A fine-grid analysis was performed for critical receptors (identified in the coarse-grid runs) that included the proposed source stack emissions and other background PSD and baseline sources. Table 7-14 summarizes maximum proposed source impacts due to the three major fugitive dust source groups. Table 7-15 summarizes the refined PM modeling analysis including proposed source fugitive and stack emissions, other PSD and baseline sources, and monitored background concentrations.

The background PSD source and baseline source emission inventories were run separately in the fine grid analysis for each applicable pollutant in order to determine PSD and baseline source impacts in combination with the proposed source impacts. The proposed source (stack emissions) air quality impacts for PM, NO_2 and Pb were scaled with reference to the proposed source SO_2 fine grid modeling analysis results. The summary of the refined modeling analysis results shown in Table 7-16 reflects the air quality impact due to the updated engineering design for the proposed source.

NAAQS/FAAQS AND CLASS II AREA IMPACT ANALYSES

The air quality impacts for the proposed source and background sources were evaluated in the refined modeling analysis with respect to the National Ambient Air Quality Standards (NAAQS) and the Florida Ambient Air Quality Standards (FAAQS) for SO_2, PM, NO_2, and Pb. The proposed source and applicable PSD source

Table 7-14. Summary of Refined (Fine Grid) Modeling Analysis Results for Proposed Source Fugitive Dust Emissions

Source Group	Averaging Time	Year (Julian Day)	Receptor Grid Coordinates (m) X	Receptor Grid Coordinates (m) Y	Highest Annual Average or Highest Second-Highest Short-Term Modeled Impact ($\mu g/m^3$)	Class II PSD Increment ($\mu g/m^3$)
Inactive Coal	Annual	(1)	(1)	(1)	(1)	19
Storage Pile	24-Hour	1984 (346)	+2300	-1000	26.8	37
Slag Storage	Annual	1982	+2500	+1500	12.3	19
Area Cell	24-Hour	1982 (153)	+2700	+1400	20.9	37
Slag	Annual	1983	+2500	-1000	13.3	19
Transfer Conveyor	24-Hour	1985 (234)	+2600	+1400	28.8	37

(1) Annual average impact is not critical for this source group.

Source: Ebasco, 1989a.

Table 7-15. Summary of Particulate Matter Refined (Fine Grid) Modeling Analysis Results

Averaging Time	Year (Julian Day)	Receptor Grid Coordinates (m.) X	Receptor Grid Coordinates (m.) Y	Highest Annual or Highest, Second-Highest Short-Term Modeled Impact ($\mu g/m^3$): Proposed Source Fugitive Dust	Proposed Source Stack	Other PSD Sources	Baseline Sources	Monitored Background Concentration ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)
Annual	1982	+2500	+1500	12.3	0.0	0.2	1.3	14.0	27.8
	1983	+2500	-1000	13.3	0.0	0.2	1.4	14.0	28.9*
24-Hour	1982 (153)	+2700	+1400	20.9	0.0	1.5	7.8	39.0	69.2*
	1984 (346)	+2300	-1000	26.8	0.0	0.0	0.0	39.0	65.8
	1985 (234)	+2600	+1400	28.8	0.0	0.0	0.5	39.0	68.3*

*Worst-case total PM air quality impacts derived from fine grid modeling analysis results for proposed fugitive dust sources and proposed and background point sources.

Source: Ebasco, 1989a.

Table 7-16. Summary of Refined (Fine Grid) Modeling Analysis Results

Pollutant	Averaging Time	Year (Julian Day, Period)	Receptor Grid Coordinates (m) X	Receptor Grid Coordinates (m) Y	Highest Annual Average or Highest Second-Highest Short-Term Modeled Impact ($\mu g/m^3$): Proposed Source	Other PSD Sources	Baseline Sources	Monitored Background Concentration ($\mu g/m^3$)[6]	Total Impact ($\mu g/m^3$)	FAAQS ($\mu g/m^3$)	PSD Source Impact ($\mu g/m^3$)	Class II PSD Increment ($\mu g/m^3$)
SO_2	3-Hour	1984 (200,5)	-1000	+2700	252.4[1]	0	38.6	31.0	322.0*	1300	252.4*	512
	24-Hour	1984 (123)	-1100	+3000	65.5[1]	0.3	15.7	10.0	91.5*	260	65.8*	91
	Annual	1986	-4500	0.0	6.1[1]	1.0	6.2	2.0	15.3*	60	7.1*	20
PM[2]	24-Hour	1982 (153)	+2700	+1400	20.9	1.5	7.8	39.0	69.2*	150	22.4	37
		1985 (234)	+2600	+1400	28.8	0	0.5	39.0	68.3		28.8*	
	Annual	1983	+2500	-1000	13.3	0.2	1.4	14.0	28.9*	50	13.5*	19
NO_2[3]	Annual	1986	-4500	0.0	3.1	0.7	1.9	10.0	15.7*	100	3.8*	25
Pb[4]	24-Hour (Calendar Quarter)	1985 (284)	1100	+3300	0.026[5]	--	--	--	0.024*	1.5	----	----

[1] Proposed source scaling factor for SO_2 = $\frac{SO_2 \text{ emissions (new)}}{SO_2 \text{ emissions (old)}} = \frac{940.8 \text{ g/sec.}}{1088.0 \text{ g/sec.}} = 0.865$. All other SO_2 impacts were modeled assuming revised design emissions data.

[2] FAAQS/NAAQS for PM are based on PM_{10}. The Class II PSD increments are based on TSP. All source impacts for PM are based on TSP since all PM was modeled as TSP. See Table 7-14 for a summary of the refined modeling analysis for proposed source fugitive dust impacts and Table 7-15 for a summary of the proposed source and background source overall PM air quality impacts.

[3] Proposed source scaling factor for NO_2 = $\frac{NO_2 \text{ emissions}}{SO_2 \text{ emissions}} = \frac{475.2 \text{ g/sec.}}{940.8 \text{ g/sec.}} = 0.505$

[4] The 24-hour Pb impact is compared to the calendar quarter Pb standard as a conservative demonstration. Proposed source scaling factor for Pb = $\frac{\text{Pb emissions}}{SO_2 \text{ emissions}} = \frac{0.328 \text{ g/sec.}}{870.4 \text{ g/sec.}} = 0.00038$. Only the proposed source impacts are required to be evaluated.

[5] Concentration based on a maximum 24-hour SO_2 impact of 68.2 $\mu g/m^3$ derived from the proposed source fine grid run for Day 284 of 1985.

[6] Monitored background concentrations are maximum values derived from the on-site PSD monitoring program operating over a nine-month period. See Table 5-4 for details.

* Worst-case total air quality impacts identified from the refined modeling analysis results for comparison with FAAQS/NAAQS and Class II PSD increments as applicable.

Source: Ebasco, 1989d

impacts were also evaluated in the refined modeling analysis with respect to the Class II PSD increments for SO_2, PM, and NO_2 for all applicable averaging times. The FAAQS/NAAQS and Class II PSD increments for the pollutants mentioned above were summarized in Table 3-1.

Sulfur Dioxide

The FAAQS/NAAQS and Class II PSD increments for SO_2 are specified in terms of 3-hour, 24-hour, and annual averaging times. The highest second-highest total SO_2 source 3-hour and 24-hour impacts were 322.0 $\mu g/m^3$ and 91.5 $\mu g/m^3$, respectively. The FAAQS for SO_2 with respect to the 3-hour and 24-hour averaging times are 1300 $\mu g/m^3$ and 260 $\mu g/m^3$, respectively. The highest annual average total SO_2 source impact was 15.3 $\mu g/m^3$, compared to the annual average SO_2 FAAQS of 60 $\mu g/m^3$. The highest second-highest total PSD source 3-hour and 24-hour SO_2 impacts were 252.4 $\mu g/m^3$ and 65.8 $\mu g/m^3$, respectively. The Class II PSD increments for SO_2 with respect to the 3-hour and 24-hour averaging times are 512 $\mu g/m^3$ and 91 $\mu g/m^3$, respectively. The highest annual average PSD source SO_2 impact was 7.1 $\mu g/m^3$, compared to the annual average Class II PSD increment for SO_2 of 20 $\mu g/m^3$. The results of the refined modeling analysis indicate that the proposed source in combination with the SO_2 background sources do not cause violations of the SO_2 FAAQS/NAAQS or Class II PSD increments.

Particulate Matter

The PM FAAQS/NAAQS (based on PM_{10}) and PM Class II PSD increments (based on TSP) are specified in terms of 24-hour and annual averaging times. The highest, second-highest total PM source 24-hour impact was 69.2 $\mu g/m^3$, compared to the 24-hour average FAAQS for PM of 150 $\mu g/m^3$. The highest total PM source annual average impact was 28.9 $\mu g/m^3$, compared to the annual average FAAQS for PM of 50 $\mu g/m^3$. The highest, second-highest total PSD source 24-hour PM impact was 28.8 $\mu g/m^3$, compared to the 24-hour average Class II PSD increment for PM of 37 $\mu g/m^3$. The highest total PSD source annual average PM impact was 13.5 $\mu g/m^3$, compared to the annual average Class II PSD increment for PM of 19 $\mu g/m^3$. The results of the refined modeling analysis indicate that the proposed source in combination with the PM background sources do not cause violations of the PM FAAQS/NAAQS or Class II PSD increments.

Nitrogen Dioxide

The FAAQS/NAAQS and Class II PSD increment for NO_2 are specified in terms of an annual averaging time. The highest total NO_2 source annual average impact was 15.7 $\mu g/m^3$ compared to the annual average FAAQS for NO_2 of 100 $\mu g/m^3$. The highest total PSD source annual average NO_2 impact was 3.8 $\mu g/m^3$, compared to the annual average Class II PSD increment for NO_2 of 25 $\mu g/m^3$. The results of the refined modeling analysis indicate that the proposed source in combination with the NO_2 background sources do not cause violations of the NO_2 FAAQS/NAAQS or Class II PSD increment.

Lead

The air quality impact assessment for the proposed source Pb emissions assumed a 24-hour maximum impact rather than a calendar quarter average impact to be compared to the ambient air quality standard for Pb set at 1.5 $\mu g/m^3$, calendar quarter average. The FDER approved this approach (Rogers, 1989b) as a conservative approach so that use of the ISCLT model would not be required in the analysis. The highest 24-hour SO_2 impact resulting from the proposed source refined phase modeling analysis was scaled for Pb as shown in Table 7-16. The proposed source highest 24-hour average Pb impact of 0.024 $\mu g/m^3$ is well below the ambient standard of 1.5 $\mu g/m^3$ (calendar quarter average).

CLASS I AREA IMPACT ANALYSIS

The nearest PSD Class I area to the Martin Site is the Everglades National Park which is located approximately 145 km south of the site. The significant impact areas for the proposed source are greater than 50 km for SO_2, 9.5 km for PM, and 7.5 km for NO_2 as presented in Table 7-9. The results of the proposed source significant impact area analysis indicate the proposed source will not have a significant impact on the Everglades National Park for PM and NO_2.

Although the proposed source has a significant impact for SO_2 at a 50 km distance from the Martin Site, the state-of-the-art Gaussian plume models are limited to use within a 50 km distance for regulatory applications (U.S. EPA, 1987). Therefore, valid modeling techniques approved by EPA do not exist or are not sufficiently developed to justify a refined modeling analysis beyond 50 km and certainly not at 145 km from the proposed source. Given the predicted impacts at 50 km presented in Table 7-9, it is unlikely that the proposed source would significantly impact the Class I PSD area.

7.5 CONCLUSION

The results of the air quality impact assessment indicate that the proposed source air quality impacts in combination with all applicable background sources' air quality impacts do not cause a violation of the applicable ambient air quality standards or Class I and II PSD increments.

8.0 ADDITIONAL IMPACTS ANALYSIS

The PSD permit application must include an additional impacts analysis for each pollutant subject to review (U.S. EPA, 1980b). As previously described, the proposed source is subject to PSD review for SO_2, PM, NO_2, CO, VOC/O_3, Be, Hg, and As. The purpose of this analysis was to determine the proposed source's air pollution impacts on soils, vegetation and visibility, and the emissions impacts resulting from commercial, residential, industrial, and other growth associated with the proposed facility. These analyses are presented under the subheadings that follow.

8.1 Impacts to Soils

Air contaminants can affect soils through fumigation by gaseous forms, accumulation of compounds transformed from the gaseous state, or direct deposition of particulates or particulate matter to which certain contaminants are absorbed. Gaseous fumigation of soils does not directly affect the soil but rather the organisms found in the soils. Concentrations higher than the predicted levels are required before any adverse effects from fumigation are observed. It is more likely that effects on soils and hence the organisms (plants and animals) found in the soils could occur from the deposition of trace elements. On this basis, the impacts analysis on soils specifically addresses the effects of trace element deposition potential accumulation, and pathways for movements into the food chain.

Estimated emissions for five trace elements are predicted to occur under one or more of the five scenarios (representing three fuel types), as documented in Tables 2-1 through 2-6. The methodology used in estimating trace element deposition rates and soil concentration increases is detailed in Appendix 10.5.6.7. Elements considered to be volatile were assumed to exit the stacks in an uncontrolled manner. Those trace elements typically occurring as particulates or adsorbed on particulates were also assumed to exit in an uncontrolled state. The trace element emission rates for each of the proposed fuel options were reviewed and the highest emission rate for a given trace element was used to provide a worst case analysis. In addition, the use of these assumptions introduced a degree of conservatism to the assessment.

Studies of model power plants by Dvorak et al. (1977), Dvorak and Pentecost et al. (1977), and Vaughan et al. (1975) in most cases predicted increases in soil trace element levels of less than 10 percent of the total endogenous concentrations over the life of the model plant. It was concluded that uptake by vegetation could not increase dramatically unless the forms of deposited trace elements were considerably more available than the endogenous forms (U.S. Fish and Wildlife Service, 1978). A summary of the sensitivity of vegetation to the five trace elements selected for study is presented in Appendix 10.5.6.7.

The estimated annual percent increase in soil concentrations, attributed to the proposed CG/CC plant, of the five trace elements reviewed are presented in Table 8-1. The estimated increases ranged from 5.85×10^{-7} to 1.66×10^{-2} percent, using average soil background concentrations found in the U.S. as obtained from the literature (Horton et al., 1977; U.S. Fish and Wildlife Service, 1978; Environmental Research and Technology, 1978). The estimated percent increases over the 30 year life of the plant, assuming that the elements remained concentrated in the top 25 cm of soil over this period, ranged from 1.76×10^{-5} to 4.9×10^{-1}. The assessment of these estimated increases was based on a number of worst case

Table 8-1. Percent Increases in Soils, Worst-Case Emissions

Trace Elements	Average Background Soil Concentration (ppm)	Estimated Soil Concentration Increase (mg/kg/yr)[1]	Percent Increase Due to Emissions From the Proposed Martin CG/CC Project: Per Annum	Percent Increase Due to Emissions From the Proposed Martin CG/CC Project: 30 Year Plant Life
Arsenic	6	1.28E-05	2.13E-04	6.40E-03
Beryllium	6	2.98E-06	4.97E-05	1.49E-03
Fluorides	200	3.48E-05	1.74E-05	5.22E-04
Lead	10	9.95E-06	9.95E-05	2.98E-03
Mercury	0.1	1.49E-05	1.49E-02	4.48E-01

[1] Note that a 1 mg/kg increase corresponds to a 1 ppm increase in concentration.

Source: Envirosphere Company, 1989.

conditions, which are described in Appendix 10.5.6.7. Under these conditions, which are not likely to occur during typical operation of the proposed plant, an increase in the levels of most trace elements in soil should not be perceptible on an annual basis. Over the 30 year plant life, those elements exhibiting a higher percent increase relative to the others studied or are designated as criteria pollutants include; lead and mercury.

Lead

The estimated soil increase for lead would be 2.98×10^{-4} mg per kg of soil over the 30 year plant life. Naturally occurring lead concentrations in soil averages about 10 ppm. Based on reported threshold concentrations of 10 ppm lead in solution culture (Valkovic, 1975), the addition of 2.98×10^{-4} mg lead per kg of soil to soils containing as much as 10 ppm lead should not result in any adverse effects.

Mercury

The estimated soil increase for mercury would be 4.47×10^{-4} mg per kg of soil over the 30 year plant life. Naturally occurring mercury concentrations in soil average 0.1 ppm. Most higher vascular plants are resistant to toxicity from high Hg concentrations even though high concentrations are present in plant tissue. Concentrations of 0.5-50 ppm ($HgCl_2$) were found to inhibit the growth of cauliflower, lettuce, potato, and carrots (Bell and Rickard, 1974). The addition of 4.47×10^{-4} mg per kg of soil is not considered to result in an adverse effect.

8.2 IMPACTS TO VEGETATION

Effects of air contaminants on vegetation occur primarily from sulfur dioxide, nitrogen dioxide, ozone, and particulates. Effects from minor pollutants, chlorine, hydrogen chloride, ethylene, ammonia, hydrogen sulfide, carbon monoxide, and pesticides, have also been reported. However, these pollutants have not resulted in major economic problems. Some such as ethylene are widely distributed but due to low concentrations cause no injury to plants. Others such as CO do not cause damage at concentrations normally found in urban atmospheres. Others would occur only under accidental release incidents.

The effects of contaminants are dependent both on the concentration of the contaminant and the duration of the exposure. Injury to vegetation from exposure to various levels of air contaminants can be termed acute, physiological, or chronic. The term injury, as opposed to damage, is commonly used to describe all plant responses to air contaminants and will be used in the context of the following assessment. Acute injury occurs as the result of a short term exposure to a high contaminant concentration and is typically manifested by visible injury symptoms ranging from chlorosis to necrosis. Physiological or latent injury occurs as the result of a long term exposure to contaminant concentrations below that which results in acute injury symptoms, while chronic injury results from repeated exposure to low concentrations over extended periods of time.

The technique for assessing the effects of air contaminants on vegetation involves the comparison of concentrations reported in the scientific literature as causing deleterious effects on vegetation. These concentrations or threshold values are best estimates based on one or more scientific studies. While it is recognized that these threshold values are typically not an accurate representation of threshold values, noting the exception where specially designed chambers are used under actual field conditions, threshold values used in the following assessment are considered to be conservatively low. A more detailed description of the types of injury, injury symptoms, threshold levels, and the application of threshold levels to the assessment of air contaminant effects is appended in Appendix 10.5.6.8. The results of the assessment are presented in the following sections for each air contaminant, as well as synergistic responses of air contaminants. In general, no acute injury is anticipated to vegetation on or within the immediate vicinity of the proposed Martin Site, when exposed to predicted concentrations of SO_2, NO_2, O_3, particulates, SO_2-NO_2 and SO_2-O_3. Potential physiological or chronic injury symptoms are likewise not anticipated.

Sulfur Dioxide

The predicted maximum ground level 3-hour, 24-hour and annual mean concentrations resulting from operation of the proposed plant and existing sources (including highest monitored ambient levels) are 322, 91.5, and 15.3 $\mu g/m^3$, respectively (see Table 7-16). Concentrations higher than these are predicted to occur no more than once per year. The 3-hour concentration falls below the low end of the range of the injury threshold concentrations reported in the literature for sensitive plants (Table 8-2). It is also one-third to one-half of the low end of the range of values reported as resulting in foliar injury symptoms on maples, southern pines, and rubus (Table 8-3). Under these predicted ambient conditions, no injury symptoms could be expected in the areas of predicted maximum concentrations. Citrus is reported (USEPA, 1976) as being tolerant to SO_2, with foliar injury symptoms appearing when

Table 8-2. Threshold SO_2 Concentrations for Visible Injury to Sensitive Vegetation

Exposure Period (hour)	Threshold Concentration ($\mu g/m^3$)			
	Jacobsen (1977)	Jones et al. (1974)	Linzon (1973)	USEPA (1973)
1	2000	1300-2620	1834	1300-7860
2	1050	-	1048	655-5240
3	850	786-1572	785[a]	400-3750[a]
4	750	-	681	262-2620
8	500	-	472	131-1310

[a] Interpolated value

Table 8-3. Response or Sensitivity Rating of Vegetation Typical of the Martin Site to SO_2

Vegetation	SO_2 Concentration ($\mu g/m^3$)	Exposure Period	Rating or Response	Reference
Acer sp. (maples)	118	Growing season	No leaf injury	Fed. Am. Soc. Exp. Bio. (1973)
	-	-	Resistant	Sucoff and Bailey (1971)
	2620-5240	1 hr.	Threshold level	Jones et al. (1974)
	1572-2096	3 hr.	Threshold level	Jones et al. (1974)
Acer rubra (red maple)	-	-	Tolerant	USDA (1972)
Citrus sp.	-	-	Tolerant	USEPA (1976)
Citrus aurantium	2620	2 hr./day 40 days	No leaf injury, decrease in total linear growth	Fed. Am. Soc. Exp. Bio. (1973)
Citrus mobilis var. *unshiu*	2620	2 hr./day 40 days	No leaf injury	Fed. Am. Soc. Exp. Bio. (1973)
Pinus sp. (southern pines)	3930-5240	Peak	Sensitive	Jones et al. (1974)
	2620-5240	1 hr.	Sensitive	Jones et al. (1974)
	1572-2096	3 hr.	Sensitive	Jones et al. (1974)
Pteridium aquilium (brackenfern)	-	-	Sensitive	USEPA (1976)
Quercus virginiana (live oak)	-	-	Tolerant	Loomis and Padgett (1973)
Rhus spp. (sumacs)	2620-3930	Peak	Sensitive	Jones et al. (1974)
	1310-2620	1 hr.	Sensitive	Jones et al. (1974)
Rubus spp.	2620-3930	Peak	Sensitive	Jones et al. (1974)
	1310-2620	1 hr.	Sensitive	Jones et al. (1974)
	786-1572	3 hr.	Sensitive	Jones et al. (1974)

concentrations exceed 1572-2096 $\mu g/m^3$ for a three-hour period.

No information has been reported in the technical literature concerning sensitivity of sugarcane to SO_2 (or other air pollutants derived from fossil-fuel combustion). There is some reason to suspect that sugarcane is not sensitive. Botanically similar taxa including corn (Zea mays), sorghum (Sorghum sp.) and Johnson grass (Sorghum halepense) are considered relatively resistant (Barrett and Benedict, 1970) and can continuously produce new leaves which might enable it to compensate for infrequent stresses without any loss in yield.

The potential for physiological or chronic injury occurring can not be predicted with certainty. The annual ambient concentration based on nine months of data from the field monitoring program was 2 $\mu g/m^3$. The predicted maximum annual increment from operation of the proposed plant is 6.1 $\mu g/m^3$. Combining the existing background with the plant increment and existing PSD and background sources yields a predicted maximum annual ambient concentration of 15.3 $\mu g/m^3$ (Table 7-16). Most evidence in the literature suggests that levels around 131 $\mu g/m^3$ may be conducive to physiological or chronic injury. Since there is an order of magnitude difference between the predicted maximum ambient concentration and the reported threshold concentration, the probability of physiological or chronic injury is low.

The estimated mean annual SO_2 concentrations resulting from operation of the proposed plant may possibly have a beneficial effect on the local vegetation. Soils in the southeast are typically deficient in sulfur and require additional sulfur for optimum crop yields. Orange trees are reported to require 31 kg/ha of sulfur and sugarcane 96 kg/ha of sulfur (Terman, 1978). Atmospheric SO_2 at concentrations below the injury

1978). Atmospheric SO_2 at concentrations below the injury threshold level could provide an additional source of sulfur to crops growing on sulfur deficient soils. For example, cotton plants grown in a greenhouse environment were found to absorb 40 percent of their sulfur from an atmosphere containing 26-131 $\mu g/m^3$ SO_2 (Olsen, 1957).

Sulfur can also be added to soil through washout of atmospheric SO_2 by precipitation. In Minnesota, annual sulfur additions from atmospheric SO_2 washout range from 100 lbs/acre in urban areas to 5 lbs/acre in rural areas. In southern states, the annual average is about 5 lbs/acre (Kamprath, 1972). In some cases, the amount of sulfur deposition is sufficient to meet crop requirements. However, the amount of sulfur deposition in rural areas is thought to be sufficient only to meet about 20-30 percent of crop needs.

Particulates

As indicated in Table 7-16, the maximum predicted concentration of total suspended particulates (TSP) from the new facility's stacks and fugitive sources is 13.5 and 28.8 $\mu g/m^3$ for annual and 24-hour average, respectively. The existing background concentration in the vicinity of the proposed plant, based on data from the on-site monitoring program, is 14 and 39 $\mu g/m^3$ for an annual and 24-hour average, respectively. Combined with other existing sources, the predicted maximum concentrations will be 28.9 and 69.2 $\mu g/m^3$ for annual and 24-hour average. By comparing predicted concentrations with the few injury threshold concentrations reported in the literature, it is anticipated that there will be no measurable impact from particulates.

Nitrogen Dioxide

The maximum ground level NO_2 concentration predicted to occur from plant operation (including background) for annual averaging period is 15.7 $\mu g/m^3$. This maximum concentration is well below the estimated threshold values (Table 8-4 and Table 8-5).

It is anticipated that NO_2 concentrations resulting from plant operation will not injure vegetation in the vicinity of the Martin site.

Ozone

Ozone (O_3) will not be a direct by-product from the combustion of fuel at the proposed plant, but instead is postulated to result form a complex photochemical reaction involving nitrogen oxides and hydrocarbons. Ozone formation is not well understood, although it is generally believed that it is a phenomenon occurring at long downwind distances from, but not in the immediate vicinity of, power plants. This is attributable to the kinetics and time-dependent nature of the necessary photochemical reaction.

The state-of-the-art is such that it is difficult to predict what effect the proposed plant emissions will have on ambient ozone concentrations from either a local or regional scale. It is anticipated that any potential increase in ozone concentration would be more detectable from a regional scale as opposed to a local one. The maximum one-hour ambient ozone concentration (165 $\mu g/m^3$) as reported in the plant area is below the range of threshold concentrations reported to be injurious to vegetation (Table 8-6 and 8-7), although it is expected that any effects will be limited to long downwind

Table 8-4. Threshold NO_2 Concentrations for Visible Injury to Plant Species

Exposure Period (Hour)	Threshold Concentration[a] μg/m³	
	USEPA (1976)	Thompson et al. (1974)
1	68620	1880-28200
2	37600	-
3	22560	-
4	16920	-
8	9024	4324-6580[b]
24	4324	1880

(a) Extrapolated values

(b) Values reported for 8-21 hours

Table 8-5. Response or Sensitivity Rating of Vegetation Typical of the Martin Site to Nitrogen Dioxide

Vegetation	NO_2 Concentration ($\mu g/m^3$)	Exposure Period	Rating or Response	Reference
Citrus sinensis	-	-	Intermediate sensitivity	Taylor and MacLean (1970)
	470	8 months	leaf abscission and reduced yeild	Thompson et al. (1970)
Melaleuca Leucadendra	-	-	Moderately sensitive	MacLean et al. (1968)
Citrus sinensibs (marsh seedless	376000	4-8 hours	Necrotic areas along succulent young shoots	MacLean et al. (1968)
grapefruit Valencia orange Tangelo orange Hamlin orange Temple orange)	470000	1 hour	Necrotic areas along succulent young shoots	MacLean et al. (1968)

0072-18

Table 8-6. Threshold O_3 Concentrations for Visible Injury to Plant Species[a]

Exposure Period (hour)	Ozone Concentration (µg/m^3) Sensitive	Intermediate	Tolerant
0.5	294-588	490-1176	980
1.0	196-490	392-784	686
2.0	137-392	294-588	490
4.0	98-294	196-490	392
8.0	59-196	157-392	294

(a) Heggestad and Heck (1971)

Table 8-7. Response or Sensitivity Rating of Vegetation Typical of the Martin Site to Ozone

Vegetation	SO_2 Concentration ($\mu g/m^3$)	Exposure Period	Rating or Response	Reference
<u>Acer rubrum</u> (Red maple)	-	-	Tolerant	USDA (1972)
<u>Citrus</u> sp.	-	-	Sensitive	USEPA (1976)
<u>Cornus</u> sp.	-	-	Tolerant	USEPA (1976)
<u>Nyssa sylvatica</u> (Blackgum)	-	-	Tolerant	USEPA (1976)
<u>Parthenocissus quinquefolia</u> (Virginia creeper)	784	4 hrs./day for 14 days	Leaf injury	Treshow (1970)

distances and should not significantly increase the concentrations.

SO_2 - NO_2 Synergism

Based upon the maximum predicted 1-hour CO concentration identified in the coarse grid modeling (refer to Table 7-7) maximum 1-hour SO_2 and NO_2 impacts are predicted by scaling emission rates to be approximately 510 $\mu g/m^3$ and 250 $\mu g/m^3$, respectively. Considered in isolation, the maximum predicted 1-hour concentration of SO_2 is well below the threshold level for sensitive vegetation, while the maximum predicted 1-hour concentration of NO_2 is several orders of magnitude below the estimated injury threshold. When occurring together, these concentrations exceed the range of concentrations where SO_2-NO_2 synergistic effects have been reported to occur for certain species, none of which occur on or adjacent to the proposed plant site (Table 8-8). On the basis of information reported in the literature, it is not possible to determine if vegetation in the immediate vicinity of the proposed plant would exhibit injury symptoms due to SO_2 and NO_2 synergism. Citrus is tolerant to SO_2 concentrations below 200 $\mu g/m^3$ (long term exposures) and exhibits some symptoms when exposed to long term exposures of 470 $\mu g/m^3$ of NO_2 (compared with a predicted 1-hour average of 250 $\mu g/m^3$). Citrus is considered to be of intermediate sensitivity to NO_2, exhibiting some leaf loss and reduced yields when exposed to concentrations of 470 $\mu g/m^3$ for an 8-hour period.

There is not sufficient evidence in the literature to either support or deny the possibility that synergistic effects may occur as a result of the predicted annual ambient concentrations. However, the predicted SO_2 and NO_2 concentrations (annual average) appear to be much less than

Table 8-8. Response or Sensitivity Rating of Vegetation to Mixtures of SO_2 AND NO_2

Vegetation	SO_2 Concentration ($\mu g/m^3$)	NO_2 Concentration ($\mu g/m^3$)	Exposure Period	Rating or Response	Reference
Glycine max	131	94	4 hr.	Slight leaf discoloration	Fed. Am. Soc. Exp. Bio. (1973)
(Soybean)	131-655	94-470	4 hr.	Greater than additive effect	USEPA (1976)
	262	188	4 hr.	Leaf injury (35%)	Tingey et al. (1971)
	262	282	4 hr.	Leaf injury (20%)	Tingey et al. (1971)
	524	376	4 hr.	Leaf injury (9%)	Tingey et al. (1971)
	262	94	4 hr.	No leaf injury	Tingey et al. (1971)
Medicago sativa	655	470	1 hr.	9% inhibition of CO_2 uptake	White et al. (1974)
	655	470	2 hr.	15% inhibition of CO_2 uptake	White et al. (1974)
Nicotiana tabacum	262	188	4 hr.	Leaf injury (11%)	Tingey et al. (1971)
(Tobacco)	262	282	4 hr.	Leaf injury (18%)	Tingey et al. (1971)
Lycopersicon	262	188	4 hr.	Leaf injury (1%)	Tingey et al. (1971)
esculentum (Tomato)	262	282	4 hr.	Leaf injury (17%)	Tingey et al. (1971)

that resulting in a synergistic response over longer exposure periods.

Tingey et al. (1971) report that the concentrations of SO_2 and NO_2 found to cause injury in their studies were similar to those found in urban areas and may result in reduced yields of crops grown under field conditions. However, it should be noted that synergistic effects from SO_2-NO_2 have been rarely observed in the field. In addition, data on the effects on vegetation due to mixtures of SO_2 and NO_2 are limited and the general consensus of most investigators is that more research is required before SO_2 -NO_2 synergism is completely understood and potential effects predicted for field situations.

SO_2 - O_3 Synergism

Under worst-case conditions, it is possible that some injury may occur from SO_2/O_3 synergism, given the sensitivity of citrus to O_3, which would be tempered by the tolerance of citrus to SO_2. The probability of this occurring is greater in the spring months than in other months due to the higher O_3 concentrations recorded by the on-site monitoring program during this time period. This potential SO_2/O_3 synergism should be restricted to the area where the maximum SO_2 concentrations are predicted to occur. The probability that the facility operating characteristics and meteorological parameters resulting in the maximum predicted concentrations of both pollutants (used in the injury assessment) will actually occur is low. Therefore, the probability that synergistic effects will occur on vegetation in the vicinity of the proposed plant site is also considered to be low. The maximum SO_2 concentrations are predicted to range from 520 $\mu g/m^3$ (1-hour average) to 322 $\mu g/m^3$ (3-hour average) to 91.5 $\mu g/m^3$ (24-hour average). As a means of comparison to concentrations resulting in a synergistic response as reported in the literature (Table 8-9), which are based primarily on 4-hour averages, it is assumed that the maximum concentration for a 4-hour average would be below this range, with an approximate value of 300 $\mu g/m^3$. The maximum ozone concentrations recorded during the on-site monitoring ranges from 165 $\mu g/m^3$ (1-hour average) to 65 $\mu g/m^3$ (9-month average). From this range a 4-hour average is estimated to be approximately 125 $\mu g/m^3$. In a conservative sense, the maximum concentrations of SO_2 and O_3 expected would be approximately 300 and 125 $\mu g/m^3$, respectively, for a 4-hour averaging period. These SO_2 and O_3 concentrations are typically below the range of concentrations where synergistic responses have been reported in the literature for species not found on the proposed plant site.

Fugitive Dust Emissions

Little or no effect on vegetation from fugitive dust is anticipated due to the dust suppression measures to be implemented at each of the potential fugitive dust emission points. Precipitation will also tend to wash off any accumulations, thereby reducing the possibility of injury.

8.3 IMPACTS TO VISIBILITY

Section 169A of the Clean Air Act Amendments of 1977 provide for implementation of guidelines to prevent visibility impairment in mandatory PSD Class I areas. The guidelines are intended to protect the aesthetic quality of these pristine areas from reduction in visual range and atmospheric discoloration due to various pollutants. The nearest PSD Class I area to the proposed facility is the Everglades National Park located approximately 145 km south of the facility.

Table 8-9. Response or Sensitivity Rating of Vegetation to Mixtures of SO_2 AND O_3

Vegetation	SO_2 Concentration ($\mu g/m^3$)	O_3 Concentration ($\mu g/m^3$)	Exposure Period	Rating or Response	Reference
Brassica oleracea capitata (Cabbage)	1310	98	4 hr.	Leaf injury (4%)	Tingey et al. (1973b)
	262	196	4 hr.	Leaf injury (22%)	Tingey et al. (1973b)
	655	196	4 hr.	Leaf injury (14%)	Tingey et al. (1973b)
	1310	98	4 hr.	Leaf injury (54%)	Tingey et al. (1973b)
Glycine max (Soybean)	2620	196	4 hr.	Additive effect USEPA (1976)	
	131	98	6 hr.	Leaf injury and decreased growth	Tingey et al. (1973b)
	98	98	6 hr.	Leaf injury and decreased growth	Heagle et al. (1974)
	196	196	6 hr.	Leaf injury and decreased growth	Heagle et al. (1974)
	655	98	4 hr.	No leaf injury	Tingey et al. (1973a)
	2620	196	4 hr.	Leaf injury (1%)	Tingey et al. (1973a)
Gossypium sp. (Cotton)	734-838	176-216	10 wks	Leaf injury and chlorosis	Fed. Am. Soc. E. Bio. (1975)
Lycopersicon esculentum (Tomato)	1310	98	4 hr.	Leaf injury (1%)	Tingey et al. (1973b)
	262	196	4 hr.	Leaf injury (50%)	Tingey et al. (1973b)
	655	196	4 hr.	Leaf injury (10%)	Tingey et al. (1973b)
	1310	196	4 hr.	Leaf injury (13%)	Tingey et al. (1973b)
Medicago sativa (Alfalfa)	1310	98	4 hr.	Leaf injury (2%)	Tingey et al. (1973b)
	262	196	4 hr.	Leaf injury (24%)	Tingey et al. (1973b)
	655	196	4 hr.	Leaf injury (21%)	Tingey et al. (1973b)
	1310	196	4 hr.	Leaf injury (60%)	Tingey et al. (1973b)
Nicotiana tabacum	1310	98	4 hr.	Leaf injury (60%)	Tingey et al. (1973b)
	262	196	4 hr.	Leaf injury (95%)	Tingey et al. (1973b)
	655	196	4 hr.	Leaf injury (88%)	Tingey et al. (1973b)
	1310	196	4 hr.	Leaf injury (96%)	Tingey et al. (1973b)

A level-1 visibility screening analysis was performed to determine the potential adverse visibility effects using the approach recommended in the "Workbook for Estimating Visibility Impairment" (U.S. EPA, 1980). Three plume and sky contrast parameters are estimated using the SO_2, PM and NO_2 emissions for the proposed source. If the absolute values of these parameters are greater than 0.10, the emission source fails the level-1 visibility screening test, and further analysis is required to assess potential visibility impairment. If the absolute values of the contrast parameters are all less than 0.10, the emission source would probably not cause adverse visibility impairment in PSD Class I areas and further analysis of potential visibility impacts is considered to be unnecessary by EPA.

The approach and assumptions used to calculate the contrast parameters are described in the following steps.

<u>Approach</u>

Step 1 --

Compute the plume dispersion parameter, p, at the minimum distance between the emissions source and the closest boundary of the PSD Class I area.

$$p = \frac{2.0 \times 10^8}{\sigma_z X}$$

where: σ_z =Pasquill-Gifford vertical dispersion coefficient (meters), for class F atmospheric stability conditions at downwind distance, X (km). Note that if X>100 km, set σ_z = 100 meters.

Step 2 --

Compute the optical thickness, τ, based on emissions of PM and nitrogen oxides (NO_x) as NO_2:

$$\tau_{PM} = 10 \times 10^{-7}\ p\ Q_{PM}$$

$$\tau_{NOx} = 1.7 \times 10^{-7}\ p\ Q_{NOx}$$

where: τ_{PM} = PM optical thickness,

τ_{NOx} = NO_x optical thickness,

Q_{PM} = PM emissions (metric tons/day), and

Q_{NOx} = NO_x emissions (metric tons/day)

Step 3 --
Determine background visual range value (r_{vo}), km, at the location of the emission source and PSD Class I area. If the emission source and Class I area are in different visibility regions, use the larger value of r_{vo} in subsequent calculations (see Figure 13 in U.S. EPA (1980)).

Step 4 --
Calculate the optical thickness parameter for primary and secondary aerosol, τ_A:

$$\tau_A = (1.06 \times 10^{-5})\ (r_{vo})\ (Q_{PM} + 1.31\ Q_{SO2})$$

where: Q_{SO2} = SO_2 emissions (metric tons/day)

Step 5 --
Calculate the contrast parameters:

$$C_1 = \frac{\tau_{NOx}}{(\tau_{PM} + \tau_{NOx})} [1 - \exp(-\tau_{PM} - \tau_{NOx})][\exp(-0.78\ (X)/r_{vo})],$$

$$C_2 = [1 - (\underline{\quad 1 \quad})\ \exp(-\tau_{PM} - \tau_{NOx})]\ [\exp(-1.56\ (X)\ /r_{vo})]$$

$$C_1 + 1$$

$$C_3 = 0.368 \, [1 - \exp(-\tau_A)]$$

where: C_1 = plume contrast against the sky,
C_2 = plume contrast against terrain, and

C_3 = change in sky/terrain contrast caused by primary and secondary aerosol.

Project-Specific Design Information

For the Martin Site, the proposed CG/CC project information is as follows (assuming the worst-case emissions scenario is No. 2 distillate fuel oil 100% load at 40°F:

X = 145 km (minimum distance to Everglades National Park, a PSD Class I area),

σ_z = 100 meters (X>100 km, σ_z = 100 m),

Q_{PM} = 5.71 metric tons/day

Q_{NOx} = 41.07 metric tons/day

Q_{SO2} = 81.28 metric tons/day

Calculations

Step 1 --

$$p = \frac{2.0 \times 10^8}{(100)(145)}$$

$$p = 13{,}793.1$$

Step 2 --

$$\tau_{PM} = 10 \times 10^{-7} \times (13,793.1) \times 5.71$$

$$\tau_{PM} = 0.07876$$

$$\tau_{NOx} = 1.7 \times 10^{-7} \times (13,793.1) \times 41.07$$

$$\tau_{NOx} = 0.09630$$

Step 3 --

$$r_{vo} = 40 \text{ km}$$

Step 4 --

$$\tau_A = (1.06 \times 10^{-5})(40)(5.71 + 1.31(81.28))$$

$$\tau_A = 0.04757$$

Step 5 --

$$C_1 = \frac{0.09630}{(0.07876 + 0.09630)} \times [1-\exp(-0.07876 - 0.09630)]$$

$$\times [\exp(-0.78(145)/40)]$$

$$C_1 = 0.00523$$

$$C_2 = [1 - (\frac{1}{0.00523 + 1}) \exp(-0.07876 - 0.09630)]$$

$$\times [\exp(-1.56(145)/40)]$$

$$C_2 = 0.00002$$

$$C_3 \quad 0.368 [1 - \exp(-0.04757)]$$

$$C_3 = 0.01710$$

Conclusion

The absolute values of C_1, C_2 and C_3 are less than 0.10. As a result, it is highly unlikely that emissions from the proposed source would cause adverse visibility impairment in the Everglades National Park. Therefore, no further analysis of visibility impairment is necessary.

8.4 GROWTH ANALYSIS

The growth analysis considers air quality impacts due to emissions resulting from the industrial, commercial, and residential growth associated with the project. Only impacts related to permanent growth are considered; emissions from temporary sources and mobile sources are not addressed in the growth analysis. The analysis of socioeconomic effects presented in Chapter 7.0 of the Site Certification Application serves as the basis for this growth analysis.

Up to 1200 people will be employed at the Martin Site during the six-year construction phase, and approximately 800 permanent jobs will be filled to operate the completed facility. It is anticipated that the majority of the construction workers will commute from their current residences, whereas almost all of the 800 operational employees will migrate into the three-county region (Martin, Okeechobee, and St. Lucie Counties) or Palm Beach County. Including the indirect jobs created by the influx of operations workers, a total of 4514 persons (workers and their families) are predicted to move into the region as a result of the new FPL Martin facilities. This will account for about 2.8 percent of the projected increase of 162,000 persons for the three-county region by the year 2000.

A considerable amount of residential and commercial development will be associated with this population influx (construction of new homes and rental property; establishment of new businesses to provide goods and services). However, the permanent non-mobile-source emissions and impacts of this development will likely be small and have impacts on different areas than those affected by emissions of the new CG/CC facilities at the Martin site.

Development of industries supporting the new CG/CC plant are expected to be negligible. Raw materials consumed by the facility (fuels, limestone, etc.) will be delivered to the site in usable form from outside of the region. Further processing, such as water treatment and the coal gasification process including the oxygen plant, will be accomplished entirely on-site.

In addition to electricity, the new facility will produce two saleable by-products, sulfur and slag. Slag has proven successful as a lightweight synthetic aggregate for use in pre-cast products, such as concrete blocks and roofing tiles, and in structural concrete. Sulfur, depending upon its purity, has several different industrial applications. The economic feasibility of these accessory industries remains to be determined, but there is a possibility for one or more spin-off industries to locate in the area near the Martin site. Potential emissions from such an industry could range from almost none to rather significant. A new major source of air emissions would be subject to PSD review, including analysis of the new facility's impacts on air quality in combination with those of the CG/CC plant and any other proposed or existing facilities having overlapping significant impacts.

Electricity sales, on the other hand, will be spread out over a large region as part of FPL's generating capacity that will serve to meet increasing residential, commercial, and industrial demand throughout its system, which covers a large portion of the state of Florida.

In summary, there will be residential growth associated with the FPL Martin plant expansion, and there is potential for new industrial development nearby to take advantage of the saleable by-products of the new facility. Although it is not possible to reliably quantify the emissions and impacts resulting from the new development, they are expected to be small and well-distributed throughout the three-county region. Any large industries proposed will be subject to the stringent requirements associated with locating a PSD facility near another existing PSD source.

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10.1.6 COASTAL ZONE MANAGEMENT CERTIFICATIONS

The Coastal Management Act of 1978 (Section 380.21-380.25, Florida Statutes) requires that the Coastal Zone Management Section of FDER be responsible for certification of consistency with the Florida Coastal Management Program (FCMP) for all federal licenses, permits, activities, and projects listed in Section 380.23 (3)(c), Florida Statutes, when such activities are subject to federal consistency review and affect land or water use, are seaward of the jurisdiction of the state, or there is no state agency with sole jurisdiction for such consistency review.

In accordance with FCMP consistency evaluation procedures, copies of the following documents are included in Section 10.1 of this Site Certification Application:

a) Combined application for construction in, and discharge of dredge or fill materials to, navigable waters (Section 10 of the Rivers and Harbors Act of 1899, as amended, and Section 404 of the Water Pollution Control Act of 1972, as amended);

b) Application for National Pollutant Discharge Elimination System (NPDES) permit to discharge wastewater to navigable waters (Section 402 of the Water Pollution Control Act of 1972, as amended); and

c) Notice of Proposed Construction or Alteration (required by Part 77 of the Federal Aviation Regulations [14 CFR Part 77] pursuant to Section 1011 of the Federal Aviation Act of 1958, as amended).

Federal Consistency Evaluation Procedures (15 CFR 930.50) require these permit applications and the FAA Notice to be accompanied by a consistency certification attachment which includes:

- o A written and pictorial description of the project;
- o An assessment of probable impacts relevant to applicable FCMP statutes; and
- o A signed statement by the applicant regarding consistency of the project with FCMP statutes.

Each application included with this Site Certification Application is accompanied by such a consistency certification.

10.1.7 FAA NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION

FPL

P. O. Box 078768, West Palm Beach, FL 33407-0768
6001 Village Blvd.

November 3, 1989

U.S. Department of Transportation
Federal Aviation Administration
Southern Regional Office
Post Office Box 20636
Atlanta, Georgia 30320

FPL-JEN-DOT-170-89-51

Attention: Air Traffic Division ASO-530

Re: FPL Martin CG/CC Plant -
<u>Notice of Proposed Construction</u>

Gentlemen:

Please find enclosed a completed FAA form 7460-1, Notice of Proposed Construction or Alteration, prepared in accordance with FAA Regulations (14 CFR Part 77). Because of its proximity to nearby airports, the subject facility must comply with FAA construction notice requirements set forth in FAA regulations.

The proposed facility will include 8 combustion turbines and up to 4 coal gasification plants designed to generate electricity from the combustion of coal gas. Basic layout of the facility is shown in Figure 1, and location of the facility is shown in Figure 2. The height of the new facility's stacks and structures will range from 25 to 220 feet above ground level. All stacks and new structures will be substantially lower than the 499 foot stacks of the adjacent existing units 1 & 2.

As specified in the Federal Consistency Evaluation Procedures (15 CFR 930.50) all federal permits for which there are no analogous state permits require certification of compliance with approved Coastal Zone Management Programs. The Federal Aviation Administration Notice of Proposed Construction Alteration has no analogous State of Florida permit. Therefore, in accordance with the requirements of the Federal Consistency Evaluation Procedures, we are submitting as an attachment to this Notice a coastal management program consistency certification. As specified in 15 CFR 930.58, a copy of the FAA Form 7460-1 and the consistency certification have been sent under separate cover to the Federal Consistency Coordinator of the Florida State Planning and Development Clearinghouse.

Should you have any questions concerning the above, please do not hesitate to contact me.

Sincerely,

Wayne Ondler

Wayne C. Ondler
Principal Specialist
Environmental Affairs

WCO/kw

Enclosures

FCMP CONSISTENCY CERTIFICATION
FPL MARTIN CG/CC PLANT

DESCRIPTION OF THE PROJECT

Florida Power & Light Company (FPL) proposes to construct a coal gasification/combined cycle (CG/CC) power plant adjacent to the existing 1600 MW Martin Plant near Indiantown, Florida.

The existing Martin Plant occupies a portion of the approximately 11,300 acre Martin Site, which consists of a 6,800 acre cooling pond and a 300 acre area containing the power block for Martin Units 1 and 2. These two units have been in operation since December 1980 and June 1981, respectively.

The proposed expansion project is designed for phased implementation of four nominal 400 MW combined cycle generating modules with coal gasification plant construction to follow combined cycle power plant development. The combined cycle power plants will consist of combustion turbines (CTs), heat recovery steam generators (HRSGs), steam turbines and switchyards. The expansion project will ultimately contain all the necessary facilities to convert coal into a low sulfur, medium Btu fuel gas and generate power from the cleaned fuel. Until the gasification plants are brought on line, natural gas will serve as the primary fuel for the CTs with No. 2 fuel oil as backup. The CG/CC project, including the coal gasification plants and other facilities, will require approximately 1,300 acres of the existing site. Figure 1 of the notice provides a conceptual layout for the proposed expansion project.

Assessment of Probable Project Impacts

As part of the Federal Consistency Evaluation Procedures, an assessment of the probable impacts of the project on the coastal zone were determined in relation to the Florida Coastal Management Program (FCMP) statutes.

Flood Zones - The Martin CG/CC Plant will be within Zone B (100 to 500 year flood plain area) as defined by flood insurance rate maps. All CG/CC facility building floor elevations will be at or above the 100 year flood elevation of 31 ft. NGVD. In addition, all CG/CC facilities will be designed to comply with all applicable South Florida Water Management District (SFWMD) and Florida Department of National Resources (FDNR) requirements regarding flood protection control. Installation and operation of the CG/CC facility is expected to have no adverse impact on the 100-year flood elevations or flood flows. Since the plant will be entirely above the limits of the 100 year flood, adjacent properties owners will not be adversely affected.

Air and Water Impacts - These concerns will be addressed by obtaining the appropriate facility operation and discharge permits and using pollution control measures to abate impacts from facility construction and operations. All construction and operation permits will be obtained through the Power Plant Siting Act process in accordance with requirements established in the Prevention of Significant Air Quality Deterioration (PSD) regulations and the air quality regulations governing New Sources. The existing wastewater discharge permit (NPDES) will be modified according to the needs of the new facility.

Stormwater retention basins will be used to collect runoff waters from the site. The discharge from these basins will comply with all DER and South Florida Water Management District requirements for protection of surface and ground-water.

Archeological and Historical Resources Impacts - The Florida Division of Archives, History and Records Management has stated that there are no known or potential historical or archeological resources at the site. Therefore, no significant cultural resources will be affected by the construction or operation of the project.

Water Resource Impacts - The South Florida Water Management District (SFWMD) will review the project for water resources impacts. Consumptive use of water is anticipated, therefore permits for such use will be obtained from SFWMD. Monitoring wells will be installed to provide an early warning system of groundwater contamination, and stormwater management practices will be employed to mitigate impacts to water resources from runoff.

Power Plant Siting Act (PPSA) - An application is being filed with the Florida Department of Environmental Regulation (FDER) under the Power Plant Siting Act. This application will present information discussing the conditions resulting from construction, and the anticipated impacts from facility operation, in order to provide assurance that all applicable state, regional and local regulations are met and that the project will be consistent with the FCMP.

Consistency Determination

The proposed project complies with Florida's approved coastal management program and will be conducted in a manner consistent with such program.

June M. Small

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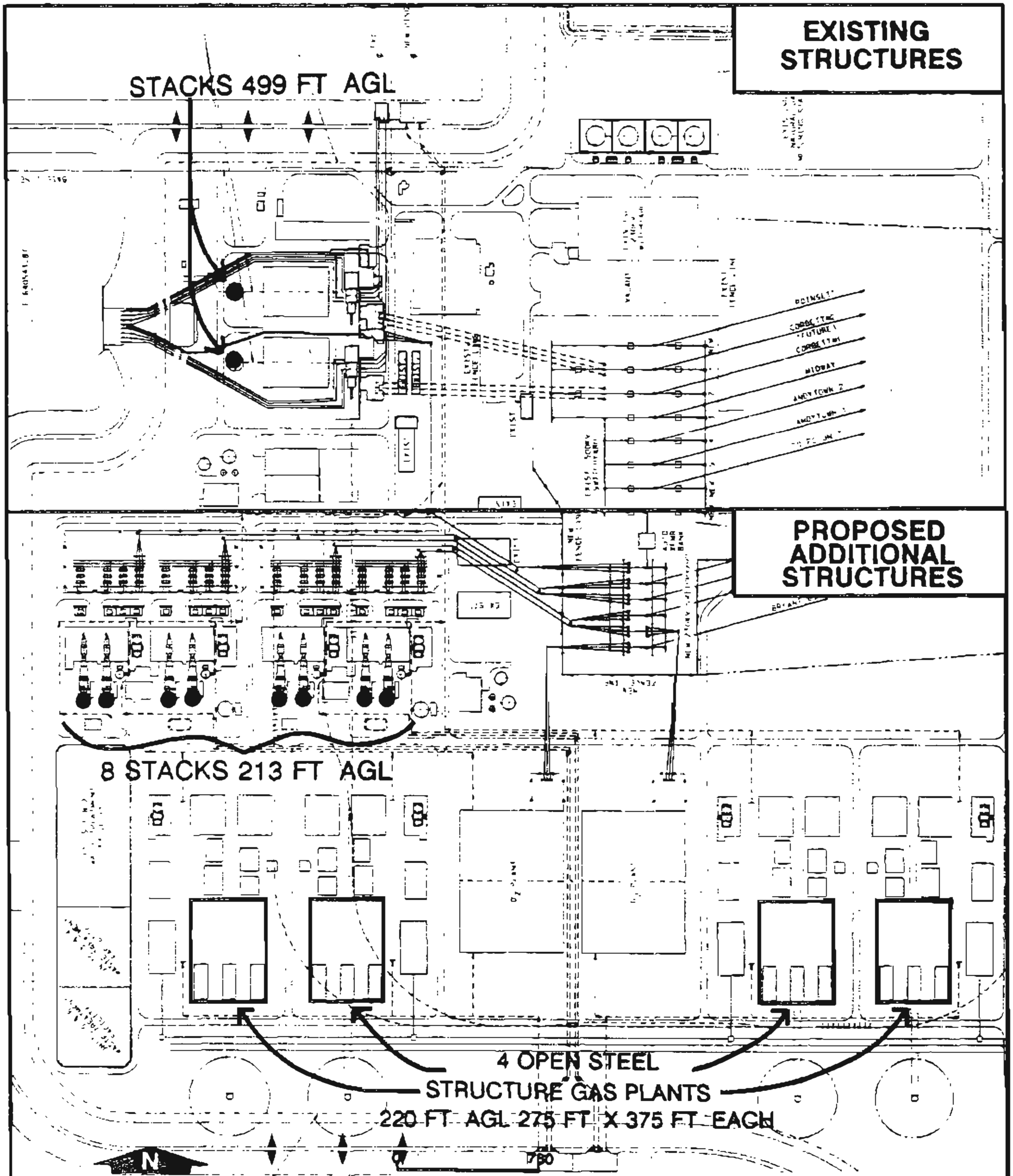

Figure: 1
MARTIN POWER PLANT STRUCTURES

ATTACHMENT 1 OF 3 TO FAA FORM 7460-1

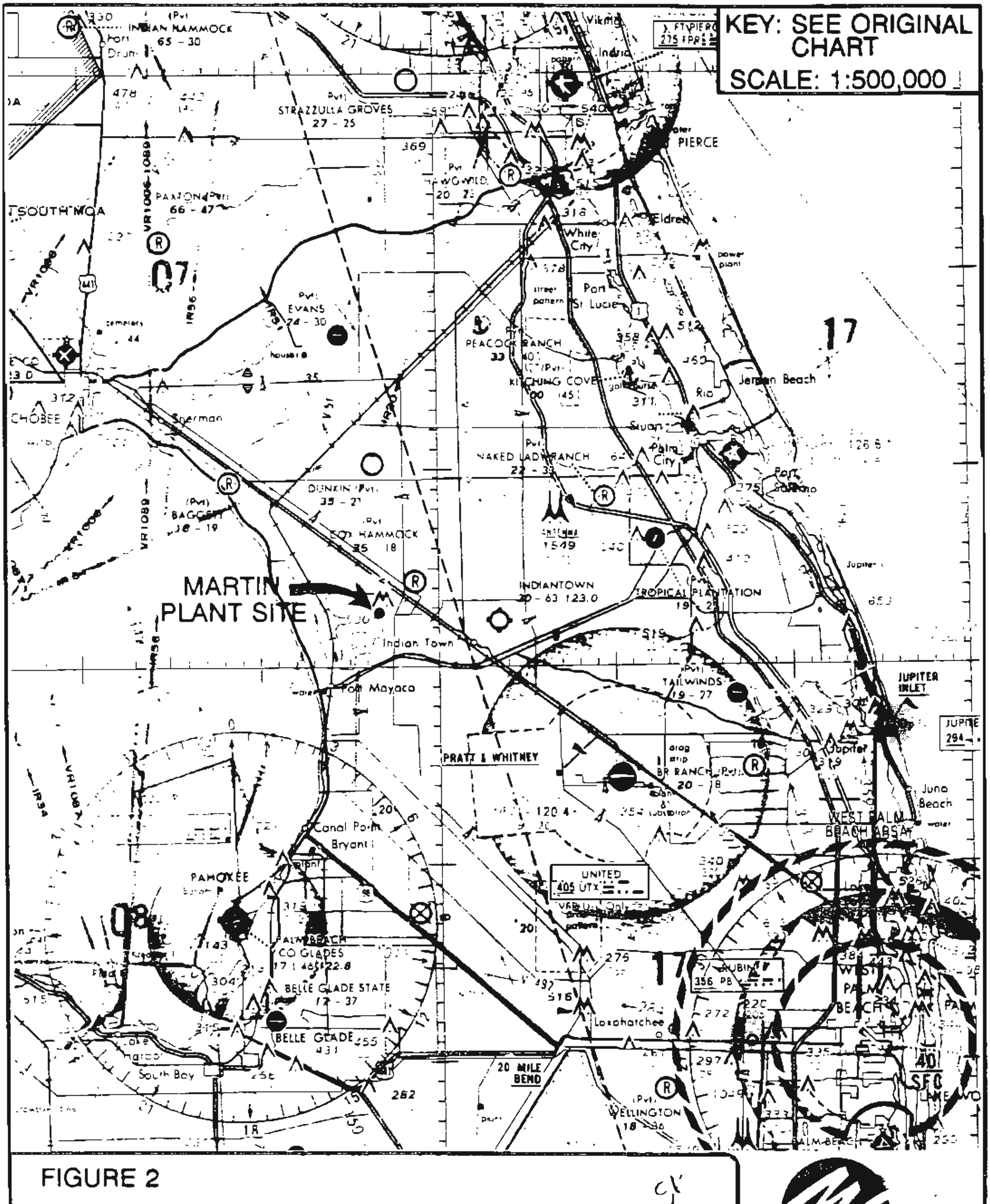

FIGURE 2

AERONAUTICAL CHART

SOURCE: MIAMI SECTIONAL AERONAUTICAL CHART, 44TH EDITION, MARCH 9, 1989

FPL

Martin CG/CC Project

TABLE 1

COORDINATES OF STRUCTURES EXCEEDING 200' IN HEIGHT
FPL MARTIN PLANT, INDIANTOWN, FLORIDA

Description	Latitude	Longitude	Height above ground (feet)	Height above mean sea level (feet)
Existing Nearby Structure:				
2 Power Plant Stacks	27 3'30"	80 33'58"	499	530
(Units 1 & 2)	27 3'33"	80 33'58"	499	530
Proposed Structures:				
8 Combustion Turbine	27 3'18"	80 34'04"	213	244
Stacks (steel)	27 3'18"	80 34'03"	213	244
	27 3'18"	80 34'01"	213	244
	27 3'18"	80 33'59"	213	244
	27 3'18"	80 33'56"	213	244
	27 3'18"	80 33'55"	213	244
	27 3'18"	80 33'52"	213	244
	27 3'18"	80 33'51"	213	244
4 Coal Gasification	27 3'9"	80 33'58"	220	251
Plant Buildings	27 3'9"	80 33'53"	220	251
(open steel structure)	27 3'9"	80 33'34"	220	251
	27 3'9"	80 33'28"	220	251

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US Department of Transportation
Federal Aviation Administration

NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION

Aeronautical Study Number

1. Nature of Proposal

A. Type	B. Class	C. Work Schedule Dates
☒ New Construction	☒ Permanent	Beginning 1991
☐ Alteration	☐ Temporary (Duration ____ months)	End 1996

3A. Name and address of individual, company, corporation, etc. proposing the construction or alteration. (Number, Street, City, State and Zip Code)

(407) 640-2040
area code — Telephone Number

June M. Small
Florida Power & Light Company
P.O. Box 078768
West Palm Beach, Florida 33407

B. Name, address and telephone number of proponent's representative if different than 3 above.

2. Complete Description of Structure

A. Include effective radiated power and assigned frequency of all existing, proposed or modified AM, FM, or TV broadcast stations utilizing this structure

B. Include size and configuration of power transmission lines and their supporting towers in the vicinity of FAA facilities and public airports

C. Include information showing site orientation, dimensions, and construction materials of the proposed structure

Units 3 through 6 of FPL's Martin Power Plant consisting of 8 combustion turbines and 4 coal gasification plants. See Table 1 and Figure 1 for additional details.

(If more space is required, continue on a separate sheet.)

4. Location of Structure

A. Coordinates (To nearest second)	B. Nearest City or Town and State	C. Name of nearest airport, heliport, flightpark or seaplane base
	Indiantown, Florida	Circle T Ranch Airport
Latitude: See Table 1	(1) Distance to 4B: 6.5 Miles	(1) Distance from structure to nearest point of nearest runway: 7.3 Miles
Longitude: See Table 1	(2) Direction to 4B: east - southeast	(2) Direction from structure to airport: East (96°)

5. Height and Elevation (Complete to the nearest foot)

A. Elevation of site above mean sea level	31'
B. Height of Structure including all appurtenances and lighting (if any) above ground, or water if so situated	See Table 1
C. Overall height above mean sea level (A + B)	See Table 1

D. Description of location of site with respect to highways, streets, airports, prominent terrain features, existing structures, etc. Attach a U.S. Geological Survey quadrangle map or equivalent showing the relationship of construction site to nearest airport(s). (If more space is required, continue on a separate sheet of paper and attach to this notice.)

6.5 miles WNW of Indiantown, Florida, 5.1 miles east of Lake Okeechobee, adjacent to south side of FPL Martin Power Plant on east side of Martin Plant cooling pond. See Figure 2 for location map.

Notice is required by Part 77 of the Federal Aviation Regulations (14 C.F.R. Part 77) pursuant to Section 1101 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1101). Persons who knowingly and willingly violate the Notice requirements of Part 77 are subject to a fine (criminal penalty) of not more than $500 for the first offense and not more than $2,000 for subsequent offenses, pursuant to Section 902(a) of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1472(a))

I HEREBY CERTIFY that all of the above statements made by me are true, complete, and correct to the best of my knowledge. In addition, I agree to obstruction mark and/or light the structure in accordance with established marking & lighting standards if necessary.

Date	Typed Name/Title of Person Filing Notice	Signature
12/12/89	June M. Small	[signature]

FAA Form 7460-1 (8-85)

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