NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

DOCKET NUMBER 50-335

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DESCRIPTION

Ltr trans the following:

PLANT NAME: St Lucie #1

ENCLOSURE

Erosion protection of sheet pile groins & Bulkheads near the earstern edge of the Ultimate heat sink.........

8-2-76 ehf

FOR ACTION/INFORMATION

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Mr Ziemann

Florida Pwr & Light Co
Miami, Fla
R E Uhrig

7-28-76

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b

Ltr trans the following:

Erosion protection of sheet pile groins & Bulkheads near the earstern edge of the Ultimate heat sink.........

St Lucie #1

8-2-76 ehf

P. O. BOX 013100, MIAMI, FL 33101

FPL

FLORIDA POWER & LIGHT COMPANY

USNRC AUG 2 1976

July 28, 1976
L-76-276

RECEIVED AUG 02 1976 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

Director of Nuclear Reactor Regulation
Attn: Dennis L. Ziemann, Chief
Operating Reactors Branch #2
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Ziemann:

Re: St. Lucie Unit No. 1 (Docket No. 50-335)
Condition of License E.1

Enclosed herewith is the information required by Section E.1 of Enclosure 1 to the St. Lucie Operating License.

This information addresses erosion protection (Sheet pile groins and Bulkheads) near the eastern edge of the Ultimate Heat Sink and consists of two parts. The analyses and drawings of Attachment A and the description of the neutralization basin structure provided by Attachment B are considered sufficient to conclude that the erosion protection will function as intended during severe hurricane wave erosion conditions.

We, therefore, request that Condition E.1 be removed from the St. Lucie Unit 1 Operating License.

Yours very truly,

Robert E. Uhrig

Robert E. Uhrig
Vice President

7713

REU/NR/hlc
Attachments

cc: Norman C. Moseley, Region II (w/Attach less Figure 1 of Attachment A)
Jack R. Newman, Esq. (w/Attach, less Figure 1 of Attachment A)

Memorandum No. 13

SUBJECT: WAVE ACTION AND SAND MOVEMENT AT THE EAST GROIN AREA.

1. The east groin at St. Lucie lies about 30 feet west of the west corner of the neutralization basin. The relation of the groin, the neutralization basin, and the security fence between the two is shown on Drawing 8770-G-516 Revision 2. (See Fig. 1, attached). This memorandum will develop an estimate of the wave action and sand movement in this area of the plant island.

2. A schematic profile taken along a north-south profile between the corner of the neutralization basin and the groin is shown on Fig. 2, attached. An estimate of the wave action and the progressive changes that could be expected in the area during the NRC stalled hurricane (Peak surge, 13.2 ft, MLW) and the Case 7 hurricane (peak surge 15.03 ft, MLW) are given in the following paragraphs.

The NRC Stalled Hurricane

3. This hurricane surge is depicted on Fig 1B of Supp. 1, App. 2H, Rev. 37 8/22/75. It has a peak surge elevation of 13.2 ft MLW occurring at Hour 59 into the hurricane. This initial rise has a duration of about 9 hours (Hour 56 to Hour 65) above elevation +9.5 ft MLW with an average elevation of about +11.25 ft MLW, the peak being at +13.2 ft as stated above. This initial peak is followed by other peaks of +12.8 ft (at Hour 72) and +12.0 ft (at Hour 84); these other two peaks, however, play no part in the east groin area as the wave directions are not from the N or NW.

4. The wave action accompanying the +13.1 ft peak is about 6.5 feet as it approaches the groin area. It is however approaching the shore at about 45° angle to the East (See Fig. 11 of Rev. 37) and would therefore be refracted as it moved onto the shore and broke; this refracted wave height would be about 5.6 feet. At the average surge elevation of +11.25 ft for this initial rise, the refracted wave height would be about 5.0 ft.

5. Actually some wave action would reach the east groin area during the 2 or 3 hours before Hour 56. However, this wave action would be only about 2 feet in height or less, so their overall effect at the east groin area would be slight, particularly since the surge elevation would be too low to bring a meaningful attack on the shore.

6. When the surge reached about elevation +11 ft, the waves would begin to bite into the slope between the neutralization basin and Big Mud Creek as shown as Fig. 2, attached. This material would be dragged offshore in an attempt to establish the equilibrium profile for this type of wave action. As the surge rose in elevation the wave action would increase in height and more and more material would be pulled out of the area between the neutralization basin and the east groin in an attempt to establish the equilibrium profile. These waves would be between 4 ft and 5.6 ft in height and would tend to establish a bench at about elevation +8 or +9. The duration of this initial rise is, as

stated in par. 3, about 9 hours. Using Fig. 9 of Rev. 37, the cumulative erosion would be about 220 cubic feet.

7. The existing ground elevation in the area between the east groin and the neutralization basin is at elevation +15.5 ft MLW. Thus, with a 34 ft cut into the area at +9 ft, the height of the face of the cut would be 6.5 feet (15.5 - 9.0). The erosion, then, would be estimated at (220/6.5=) 34 feet. The distance from the front slope to the toe of the roadway shoulder is about 80 feet, thus, the material available in a one-foot width is about (80 x 6.5=) 520 cu ft. There is, therefore, available sufficient material to prevent the wave action from eroding into the highway embankment, the indication being that the cutting action would extend only about 34 feet into the area under study in order to provide the 220 cu ft per foot of material called for in the preceding paragraph.

8. Actually, the erosion would not be expected to extend this 34 feet for three reasons:

(a) The average wave height would be about 5.0 feet, which is significantly less than the 6-foot wave height used in preparing Figure 9.

(b) Much of the wave energy at the higher surge elevations would spill westerly over the east groin and not be available to erode the area east of the groin.

(c) There is actually much more material in the area than was used in making the above calculations, as the area widens to about 80 feet to the east of the west corner of the basin while the wave energy must enter in the 30 feet between the basin corner and the groin.

From the above, it can be concluded that the erosion into the groin area would probably not be over 20 or 25 feet for the first rise of the hurricane surge. The two subsequent surge peaks would not have any significant erosion effect in the east groin as the waves would not be coming from directions that would attack this area.

9. The preceding analysis carries with it the assumption that there would be no material moving westwardly along the plant island and brought to the east groin area as littoral drift. Instead, let it be assumed that a substantial quantity of material would be brought to the east groin as is predicted on pages 9 - 11 of the erosion estimate section of Rev. 37 of 8/22/75. The question in this case would be whether or not this material would be carried to the east groin where wave action might then drive it through the gap between the groin and the neutralization basin and then over the roadway embankment and into the emergency canal - intake canal complex.

10. To examine the above situation, let it be assumed that the surface areas and slopes in and around the east groin are paved and cannot erode. Then a study will be made of what will happen to the littoral materials brought into this area by wave action. Next let the wave run-up situation be examined when the surge level peaks at +13.2 ft MLW. Under these conditions, the wave run-up would wash across the +15.5 ft MLW plateau at the rate of about 2.6 cu ft sec per foot of opening. (See pages 7-39 of Shore Protection Manual for method of computation). With a 30-foot opening between the neutralization basin and the east groin, the overtopping rate would be (30 x 2.6) 78 cu ft per sec. This 78 cu ft per sec of overtopping water is equivalent to 280,000 cu ft per hr or 17.5 x 10^6 lbs of water per hr.

11. One way of calculating the amount of sand carried onto the "plateau" by this overtopping water is to determine the concentration of sand to be expected in the overtopping water. An examination of the literature shows the following:

(a) Watts. BEB TM. 34, "Development and Field Tests of a Sample for Suspended Sediment in Wave Action," 1953. Of the 290 field samples taken at Mission Bay, California for this study, a number were in waves 4.1 to 6.0 ft in height and in depths of 5 feet or less. The highest average sand concentration (Figure 19) measured with pump-type samplers under these conditions was 1.2 parts per thousand by weight. This concentration in the 17.5 x 10^6 lbs of overtopping water (paragraph 10) would total 21,000 lbs of sand. At 2700 lbs of sand per cu yd, this would represent a total of 7.8 cu yds of sand per hour or 210 cu ft of sand per hour. For the 9 hours that the peak surge and wave direction were acting together at the east groin, the above rate would produce (9x210=) 1890 cu ft of sand or 70 cu yds for the 9-hour interval.

(b) Fairchild, 1972 Proceedings, Coastal Engineering Conference, Chapter 56, Vol. 11, "Longshore Transport of Suspended Sediment." This reference reports on the suspended sediment concentrations measured in some 800 water samples taken for this specific purpose, using a pump-type sample, off the ocean piers at Ventnor, N. J., and at Nags Head, N. C. An examination of the plot on Fig. 4 of this paper indicates that the single maximum concentration at Nags Head for waves about 3.25 feet in height was about 3.3 ppt by wt. near the bottom and about 0.53 ppt by wt. near the top, for a maximum average concentration of about 1.9 ppt over the entire length. This "maximum" average concentration (the outside envelope) converts to 2992 cu ft (110 cu yds) for the 9 hour interval as used in (a), above. In this connection, Fig 9 of this paper indicates that the sediment concentration does not vary significantly with the wave height. Thus, the use of the concentration with the 3.25 foot wave height is considered justified. (Note: These concentrations are in general agreement with the concentration of 1.2 ppt shown on Figure 19 for Mission Bay in the report of (a) above.)

(c) The Fairchild paper (Fig 12) also shows that in the large wave tank at the Coastal Engineering Research Center, a concentration of as much as 10 ppt by weight measured in the bottom layers (less than one foot off the bottom) for waves about 4 feet in height. This measurement is questionable as a similar measurement with 6 to 6.5-foot waves gave concentrations of only 0.6 ppt. However, if this 10 ppt measurement were used and assumed to represent the average concentration in the entire water mass, the quantity of sand carried ashore at the east groin site would be only 17320 cu ft (641 cu yds) for the 9-hour peak surge interval.

12. The three sand columes in the preceding paragraph for the 9-hour peak surge interval (70 cu yds 110 - cu yds, and 641 cu yds) are recognized as being too small to cause any difficulty even if washed over the roadway and into the area near the junction of the emergency canal and the intake canal. (The "safe" sand storage capacity of this junction area is well in excess of 10,000 cu yds.) Some of the sand would probably be carried westerly over the east groin so that not all of the calculated volumes would be expected to move southerly over the roadway.

13. Another quantitative indication of the ability of hurricane waves to carry sand over a coastal barrier is given in the April 1976 report "Hurricane Buelah and Camille: An Evaluation of Erosive Impact" prepared by Envirosphere Company for Florida Power and Light Company. This report reviewed intensively the history of overwashes on South Padre Island (Buelah) and the Mississippi Delta area (Camille). The summary in the report states (Page 4) that the volume of overwash varied from 1.05 to 20.3 cubic yards of sand per foot of breach width. Using the higher figure of 20.3 cu yd per foot for the 30-foot gap between the neutralization basin and the east groin, this would give an estimate of 609 cu yds of sand. It should be recognized, however, that the Buelah and Camille events involved breaching of the dune line accompanied, no doubt, by considerable flow velocities through the breach. In the absence of a breaching action near the east groin (see pars 8 and 9 above), it could not be expected that the rate of overwash would approach the 20.3 cubic yards per foot reported as an observed maximum in the Envirosphere report.

14. Another point to be noted is that the sand overwash quantities of 70, 110, and 641 cu yds per hr of par. 11 were based on the assumption that the surge stood at the elevation of +13.2 ft MLW for the entire 9 hours of the peaking interval. Actually, the average elevation during the peaking interval is about +11.25 ft MLW. At +11.25 ft elevation with a wave height (after refraction) of 5.0 ft. The overtopping note for this average condition would be slightly less than 1.0 cfs per foot of width as compared to the 2.6 cu ft / sec of par. 10. Thus, the quantity of sand overwash for the 9-hour peaking interval would be represented by figures of 27, 42 and 246 cu ft of sand per hour when based on the average overwash conditions for the 9-hour peaking interval rather than applying the overwash conditions at the +13.2 feet MLW instantaneous peak to the entire 9-hour interval.

15. The conclusion from the above analyses of the as-installed condition of the east groin, wave barrier wall and the NRC stalled hurricane indicates that there would be no breaching of the roadway behind the barrier and no serious overwash of sand onto or across the area behind the east groin.

16. A review of other PMH situations showed that one of these (Case 7) might produce more severe erosion than the NRC stalled hurricane. Thus an analysis similar to the above was made for the Case 7 hurricane; this hurricane had a max. wind radius of 20 miles and a transitional speed of 4 knots and a pressure differential of 5 in. mercury. Its peak surge height was +15.03 ft MLW with a duration of 13 hours above +8.0 ft MLW. This surge was divided into two steps for this study: one, a high step, a +15.0 ft elevation assumed to last for 3.5 hours, and one a lower step at +11.0 ft assumed to last for 9.5 hours. The waves for these two steps were 7.6 feet and 4.7 feet respectively. The erosion resulting from the first step would be 23 feet and from the second step 15 feet, for a total of 38 feet. This is 4 feet more than the 34 feet computed in paragraph 7, above.

17. As a next step, the amount of sand that might be carried landward was computed for the Case 7 hurricane in the same manner as was used for the NRC stalled hurricane in paragraphs 9-12, above. The same two steps as described in paragraph 16 were used for the Case 7 hurricane. The results indicate that, for a sediment concentration of 1.9 ppt by weight in the overtopping water, a total of 255 cu yds of sand would be carried inland between the neutralization basin and the east groin. For a sediment concentration of 10 ppt by wt., the quantity would be 1342 cu yds. This compares with totals of 110 cu yds and 641 cu yds respectively for the sand overwash quantities given for the NRC stalled hurricane in paragraph 12, above. As indicated in the text of this memorandum, the smaller overwash figures of 255 cu yds and 110 cu yds are considered to be the more realistic figures, as they are based on the maximum average concentration throughout the water mass rather than on a single maximum concentration measured very near the bottom.

18. The figures given for potential erosion and potential sand overwash for the NRC stalled hurricane and the Case 7 hurricane indicates that no severe conditions would develop in the east groin area from either cause or from a combination of the two. Thus, it can be concluded that no further treatment of this area is needed to defend against sand overtopping or wave erosion.

Joseph M. Caldwell
Consulting Engineer

JMC:pf

2 incl.
Fig. 1 Plan
Fig. 2 Profile

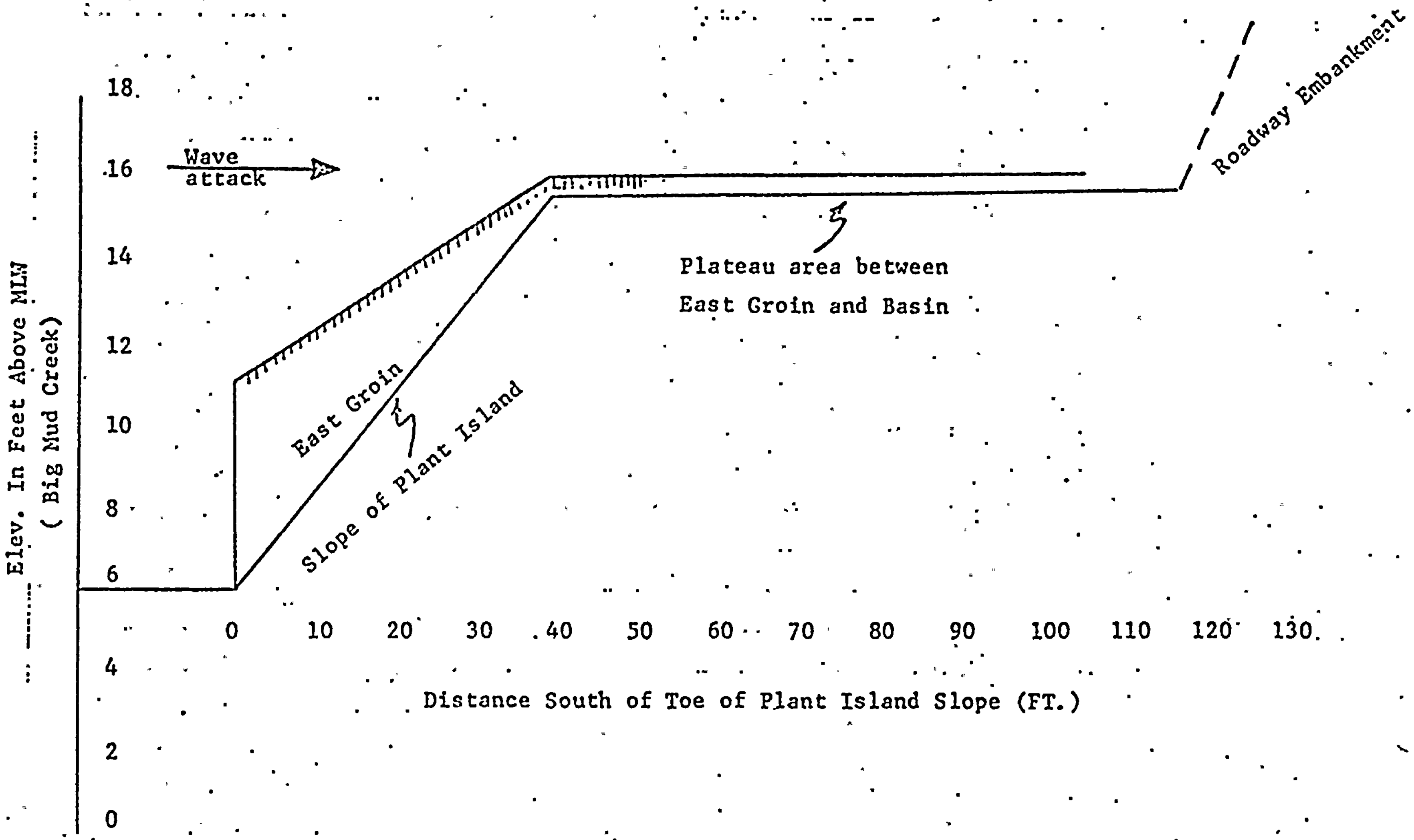


FIGURE 2
Schematic Profile of Area between the Acid Neutralization Basin and the East Groin

DESCRIPTION OF THE NEUTRALIZATION BASIN STRUCTURE

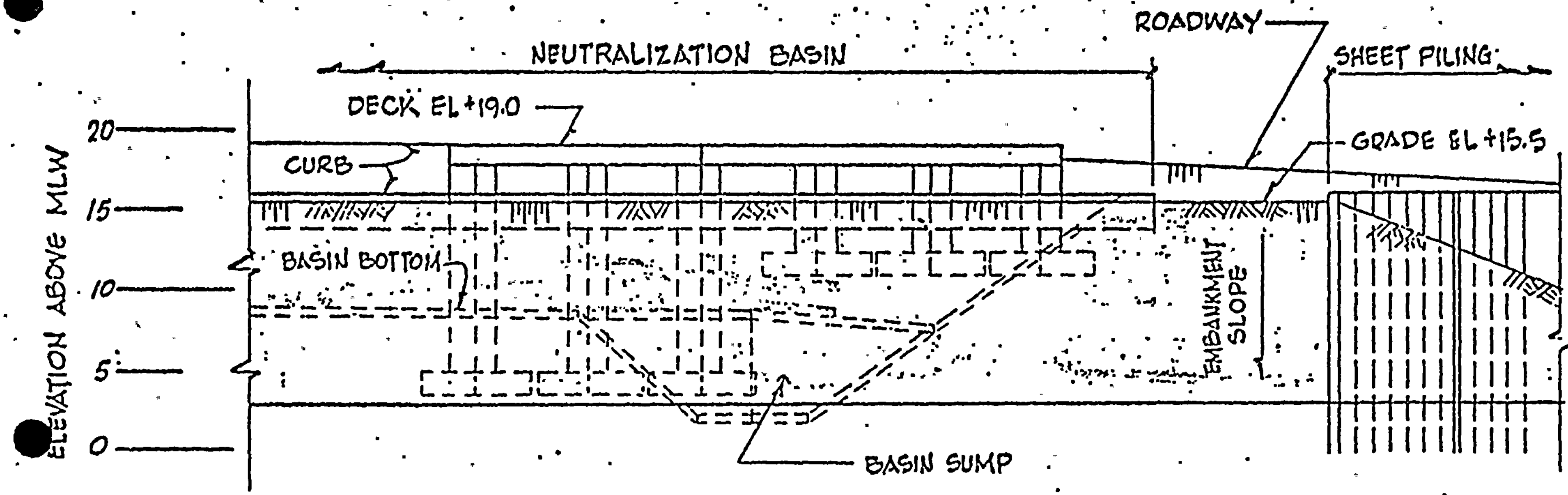
Hurricane protection is provided in the area of the Ultimate Heat Sink Canal Barrier. The protection consists of three steel sheet pile groins and a bulkhead portion. The east end of the sheet pile hurricane protection ends in the northwest corner of the plant island wherein is located the neutralization basin. A figure entitled "Neutralization Basin Area - Elevation From Big Mud Creek" is attached which shows the relationship between the neutralization basin and the hurricane protection as seen from Big Mud Creek.

The neutralization basin is a reinforced concrete structure, rectangular in shape, measuring 116 ft by 83 ft in plan. The basin is oriented with its major axis in the northeast-southwest direction. An outline of the neutralization basin is shown in Figure 9 to Supplement 2 to Appendix 2H of the St. Lucie Unit 2 PSAR and on Ebasco drawing 8770-G-516.

The bottom of the basin is a six inch thick reinforced concrete slab set at elevation +8.50 ft (approximate). A 5 foot square sump is located in the west corner of the basin at bottom elevation +3 ft. The basin side walls, also a six inch slab of reinforced concrete, slope outward at 45 degrees. The walls are capped with a one foot by one foot reinforced concrete curb at grade. The curb elevation is +16 ft on the northeast, southwest and northwest sides, and +19 ft on the southeast side.

Located in the corner of the basin closest to the hurricane sheet pile protection is a reinforced concrete deck structure measuring 22 ft by 32 ft in plan. The structure consists of a one foot thick deck supported on three 2½ foot concrete beams. The top of the deck is at elevation +19 ft. Each end is supported on three 2 ft square columns which are founded on 5 foot square by 1½ ft thick footings. All concrete design and construction is in accordance with the requirements of ACI Code 318, "Building Code Requirements for Reinforced Concrete."

ATTACHMENT B



NEUTRALIZATION BASIN

ELEVATION FROM BIG MUD CREEK

5/32" = 1'-0