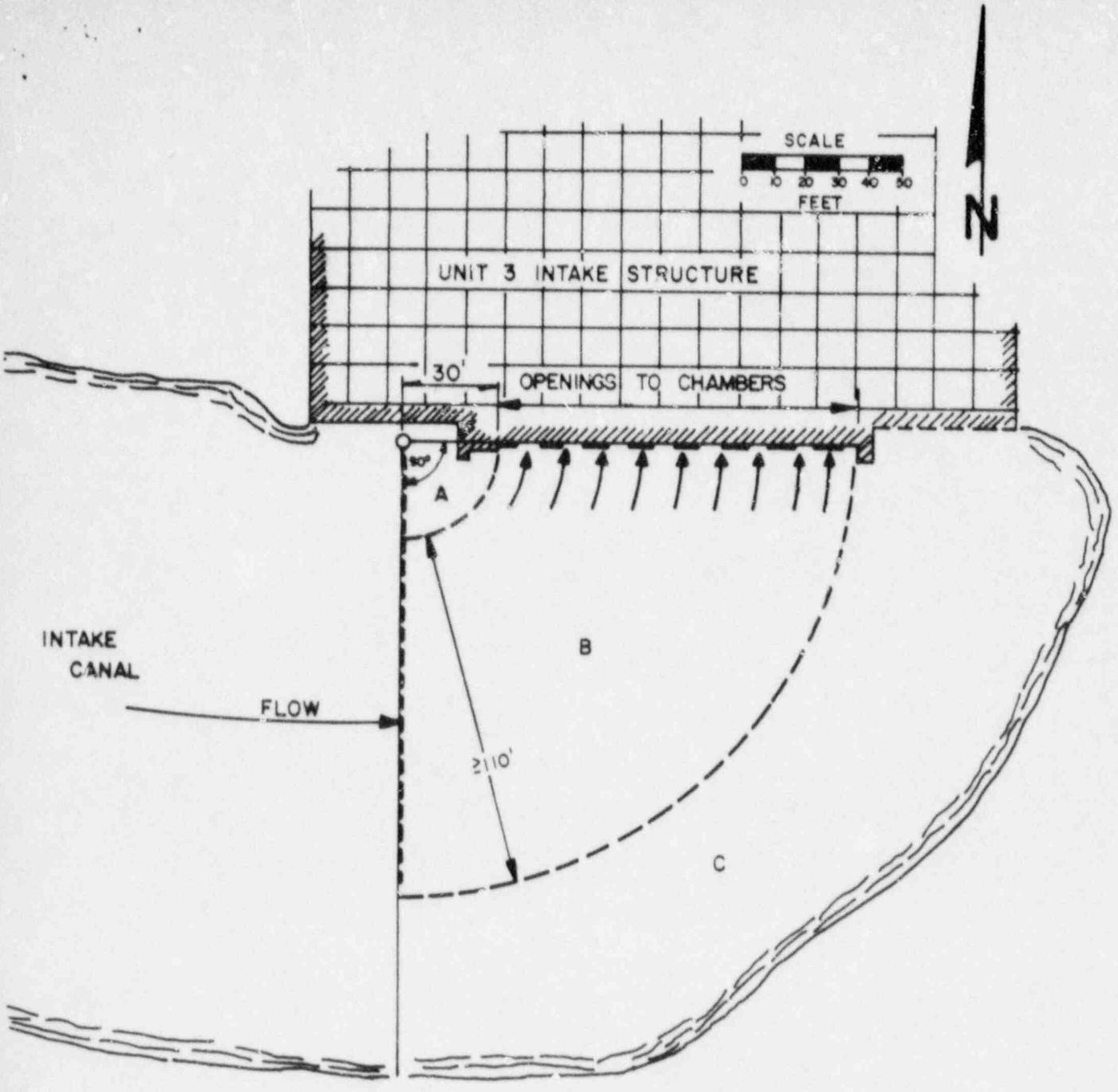
Supplemental Specification
Revision 1
(Changes to Figure 15-1a Only)



Area A - Contains no irregularities that would cause flow disturbances.

Area B - Bottom elevation $\leq$ 67.2 feet and a maximum allowed elevation change of 7 inches between horizontal increments of 5 feet.

Area C - Contains no irregularities that would cause flow disturbances.

Area A, B, & C - Surface free of floating transportable materials that would impede safety-related flow of water into the intake structure.

INTAKE CANAL CHARACTERISTICS

CANAL BEND AT CR-3

FIGURE 15-1a

Report No. 2669

CRYSTAL RIVER UNIT 3

CRITERIA FOR MAINTAINING ADEQUATE INTAKE CANAL FLOW CAPACITY

Prepared for

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$$I_a = A^{3.333}/P^{1.333}$$

and A (in square feet) and P (in feet) are the flow area and wetted perimeter, respectively, for the portion of the cross section below the reference water level.

This criterion, which is related to flow friction considerations, and the maximum bottom elevation criterion in Section 5.1.1, which is based on wind friction effects, should both be met at all locations from the Gulf end to the start of the Unit 3 bend.

5.2 Unit 3 Bend

For this report, the beginning of the canal bend approaching the Unit 3 intake structure is defined as the transect (Transect 1) perpendicular to the face of intake structure and passing through the imaginary origin point shown on Figure 3. The origin is 30 feet west of the western-most opening of the intake and in the vertical plane of the operating deck face at the top of the trash racks. Transect 1 is approximately parallel to, and about 50 feet east of, the security fence crossing the canal. The end of the bend is at the face of the intake structure.

The safety-related seawater flow is conveyed from the intake structure to the nuclear service - decay heat pump chamber via one, or both, of the two 48-inch diameter buried pipes. To enter the west pipe, water flows through trash racks into a chamber that also serves the circulating water pumps under normal operating conditions. Flow then passes from this main chamber into a separate chamber connected to the inlet of the west pipe. To enter the east pipe, water flows directly from the canal, through a trash rack, into a separate intake chamber immediately east of the other chambers. The floors of the intake chambers are at elevation 67 feet and the invert elevation at the entrance of both 48 inch pipes is 67.5 feet.

With this intake design it is necessary that safety-related flows be able to enter the full opening width of the intake structure. Within the structure, this width is 109.3 feet, including the breadth of piers separating the entrance channels. At the face of the trash racks the width is 111.7 feet.

To provide good approach conditions to the intake and to prevent bed sediment from entering the 48 inch pipes, the canal bottom in the central portion of the bend should be as smooth as practical with bottom elevations not exceeding elevation 67.2 feet. As illustrated on Figure 3, the inner and outer boundaries of the "central portion" of the bend are delineated by the elevation 67.2 foot bottom contour. Along any transect passing through the origin, the flow width of the central portion should not be less than 110 feet, the approximate overall width of the opening at the intake structure. Outside the central portion, the canal bed and curvature of the banks should be free of major irregularities.

If these criteria are met, the energy loss for the bend should be very small. This loss can be conservatively approximated by assuming that the entire 34,900 gpm safety-related flow is carried by the central portion of the bend shown on Figure 3.

Based on work by Shukry (Reference 2, pgs. 441-444), the energy loss for an open channel curve is

$$h_l = f_c \, U^2/2g$$

where f_c is a coefficient of curve resistance and U is the mean velocity. The f_c value depends on the Reynolds number (R), the angle of curvature ratio ($\theta/180$), the ratio of radius of curvature to breadth of channel (r_c/b), and the depth-breadth ratio (y/b).

With the central portion carrying 34,900 gpm during the PMH blowout condition and the associated reference water level of elevation 79 feet at the bend,

$y = 79 - 67.2 = 11.8$ feet

$b = 110$ feet

$A = yb = 11.8\ (110) = 1298$ sq. feet

$Q = 34{,}900$ gpm $= 77.8$ cfs

$U = Q/A = 0.06$ fps

$U^2/2g = (0.06)^2/64.4 = 5.6 \times 10^{-5}$

$$R = \frac{Uy}{\nu} = \frac{0.060\ (11.8)}{1.08 \times 10^{-5}\ ft^2/sec} = 6.6 \times 10^4$$

$r_c = 110/2 = 55$ feet (minimum)

$r_c/b = 55/110 = 0.50$

$y/b = 12/110 = 0.11$

$\theta = 90^o$

$\theta/180 = 0.5$

The y/b value of 0.11 is below the minimum value of 0.5 shown on experiment-based curves developed by Shukry (Reference 4, p. 443). Extrapolating these curves it appears that f_b would be less than 2. Substituting this in the loss equation,

$$h_l < 2\ (U^2/2g) < 12 \times 10^{-5} \text{ feet.}$$

This extremely small value indicates there will be negligible energy loss if the criteria for the bend are satisfied.

5.3 A General Criterion

Because adequate flow capacity of the intake canal is essential for the safe operation of Unit 3, all factors that may significantly impede the flow of water from the Gulf end to the Unit 3 intake

structure must be considered. Besides natural sediment deposits along the canal, obstructions could possibly be caused by man-made structures constructed in or over the canal, islands of seagrass, or other debris that may have entered the canal. To assure its flow capacity, the intake canal must be kept free of fixed structures and all transportable materials that could cause violation of the criteria developed in Sections 5.1.1, 5.1.3 or 5.2, or which could severely restrict the water flow capacity of the intake structure, trash racks, or traveling screens.

6.0 CRITERIA SUMMARY

The criteria summarized below have been developed to provide assurance that the intake canal can deliver essential water to Unit 3 during the design basis minimum tide hurricane. Because they should be met at all times, compliance may require over-excavation in chronic sediment deposition areas during maintenance dredging.

a. The intake canal must be kept free of fixed structures and all transportable materials that could cause violation of any of the criteria in 'b', or which could severely restrict the water flow capacity of the intake structure, trash racks, or traveling screens.

b. The following criteria refer to an imaginary origin point and to a transect (Transect 1) across the canal. As shown in Figure 3, the origin is 30 feet west of the western-most opening of the intake and in the vertical plane of the operating deck face at the top of the trash racks. Transect 1 passes through the origin and is perpendicular to the intake structure face. This transect is approximately parallel to, and about 50 feet east of, the security fence crossing the canal near the beginning of the Unit 3 canal bend.

(1) From the western-most end of the canal (approximately 6.5 miles into the Gulf of Mexico from the shoreline at

mean low water) to the beginning of the canal bend at Transect 1:

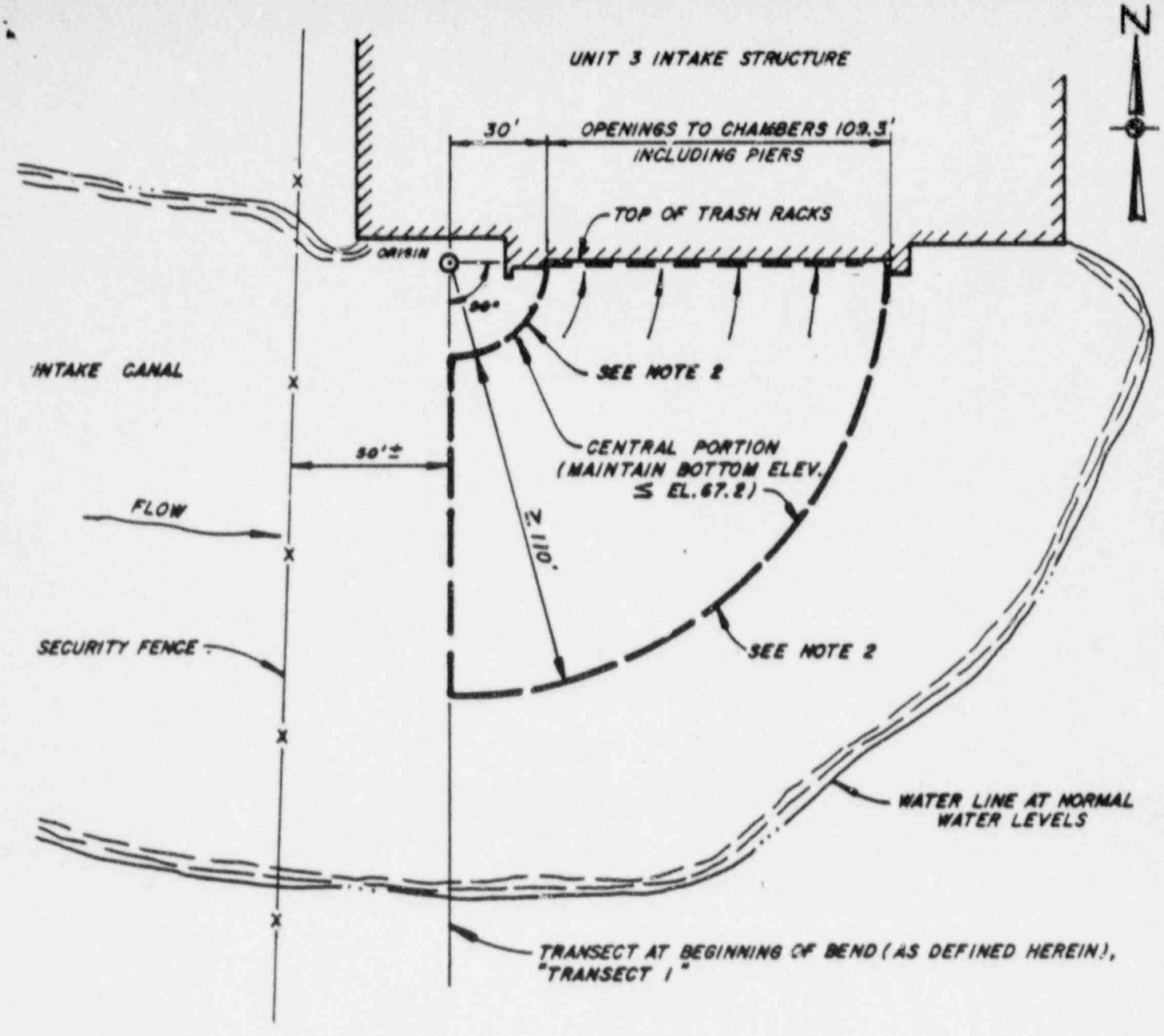
(a) The average bottom elevation at any cross section will not exceed elevation 73 feet Plant Datum for the portion of the flow cross section below the "reference water level" (H, in feet of elevation relative to Plant Datum), where H = 79 + (L/5280) and L is the distance in feet from the cross section location to the Unit 3 end of the canal.

(b) The value of the available cross section index (I_a) will not be less than 600,000, where $I_a = A^{3.333}/P^{1.333}$, and A (in square feet) and P (in feet) are the flow area and wetted perimeter, respectively, for the portion of the cross section below the reference water level (H) defined above.

(2) In the canal bend from Transect 1 to the face of the Unit 3 intake structure:

(a) The canal bottom in the "central portion" of the bend will be as smooth as practical with a bottom elevation not exceeding elevation 67.2 feet Plant Datum. The "central portion" of the bend is the area defined in plan as having a west boundary at Transect 1, a north boundary at the face of the intake structure, and the other two sides delineated by the elevation 67.2 foot bottom contour. Along any transect passing through the origin described above, the width of the central portion will not be less than 110 feet.

(b) In the remainder of the bend outside the central portion, the canal bed and the curvature of the banks must be free of irregularities that may cause flow disturbances.



NOTES:

1. ELEVATIONS ARE RELATIVE TO CRYSTAL RIVER PLANT DATUM.
2. LOCATIONS OF CENTRAL PORTION'S INNER AND OUTER BOUNDARIES (i.e., EL. 67.2' BOTTOM CONTOUR) MAY VARY FROM THOSE SHOWN, BUT THE CENTRAL PORTION WIDTH ALONG ANY TRANSECT THROUGH ORIGIN MUST BE ≥ 110'.

FIGURE 3

CRYSTAL RIVER UNIT 3

CANAL BEND AT UNIT 3

50 0 25 50

SCALE IN FEET