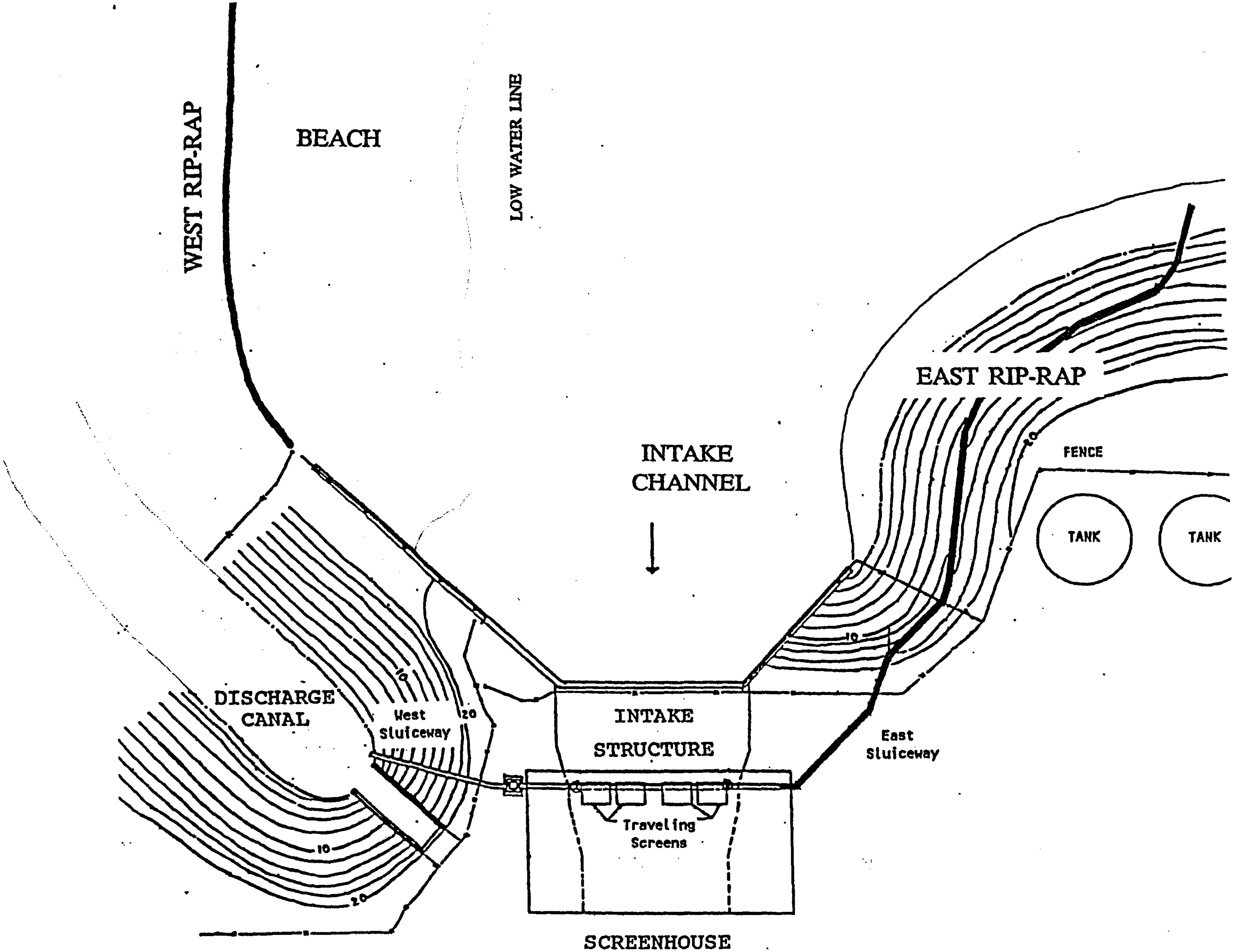
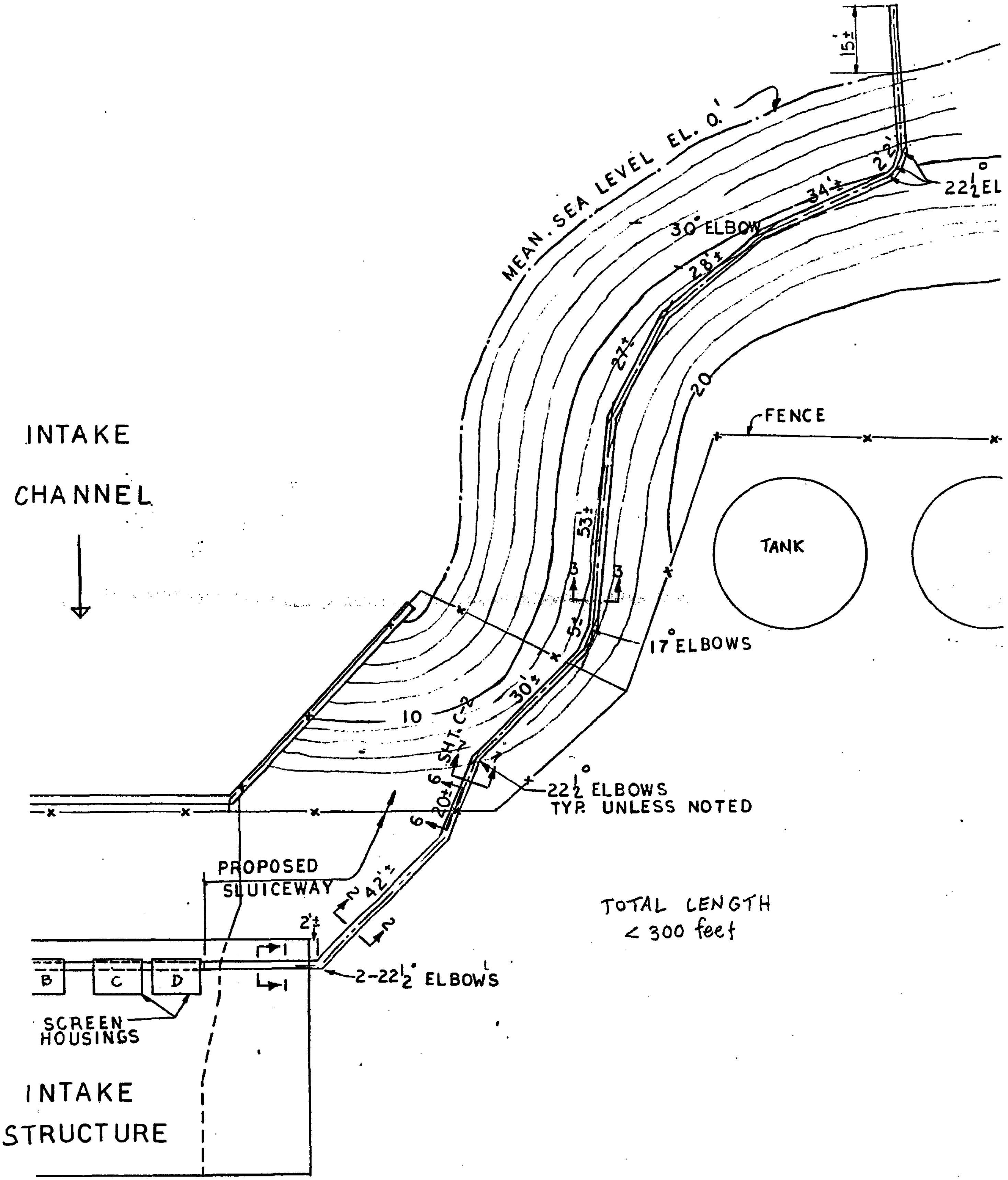
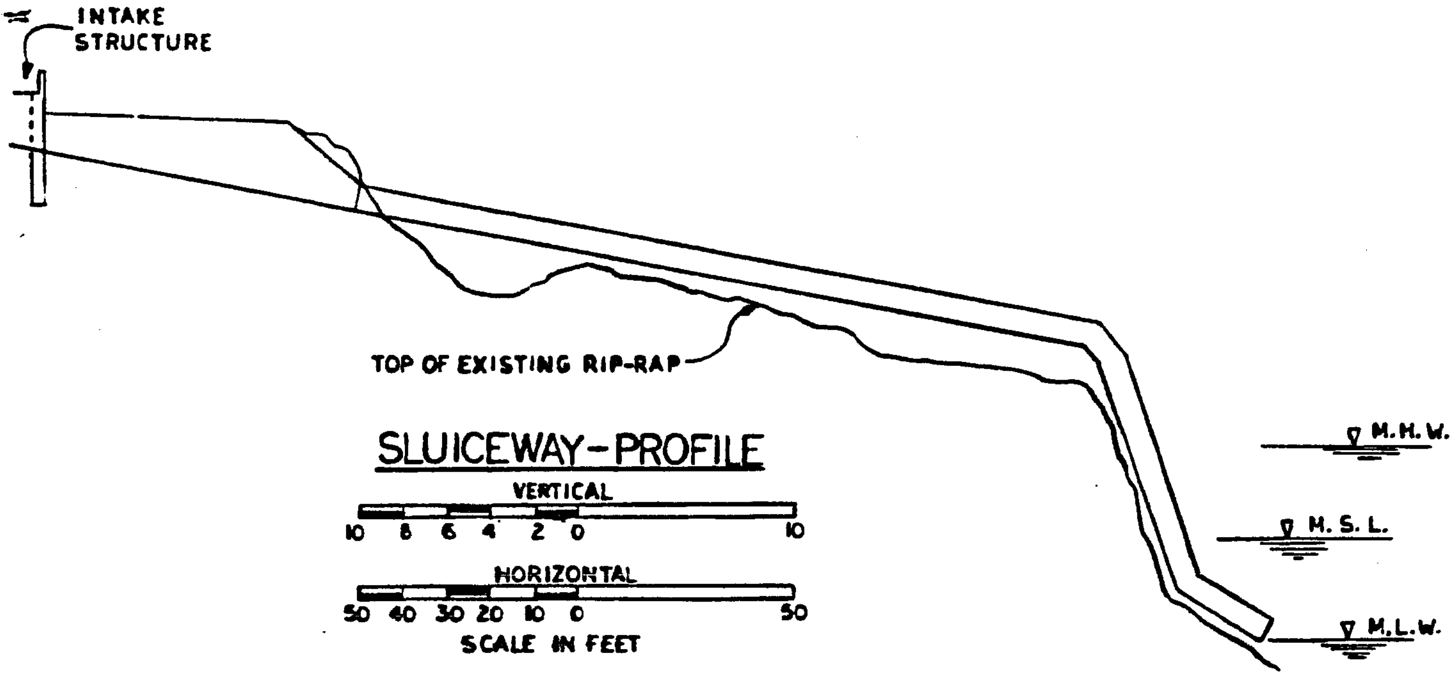

WEST RIP-RAP
BEACH
LOW WATER LINE
EAST RIP-RAP
INTAKE
CHANNEL
FENCE
TANK
TANK
DISCHARGE
CANAL
West
Sluiceway
INTAKE
STRUCTURE
East
Sluiceway
Traveling
Screens
SCREENHOUSE
10
20
10
20
10
20



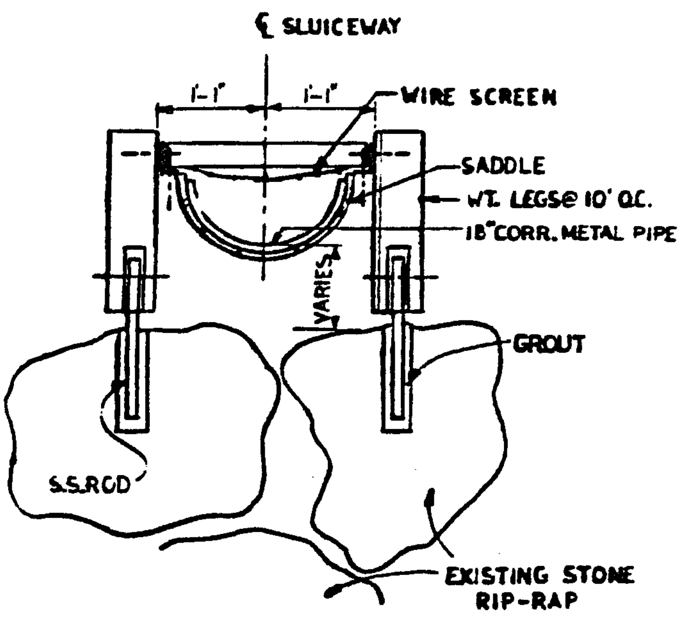
SLUICEWAY - PLAN

: 1" = 20'



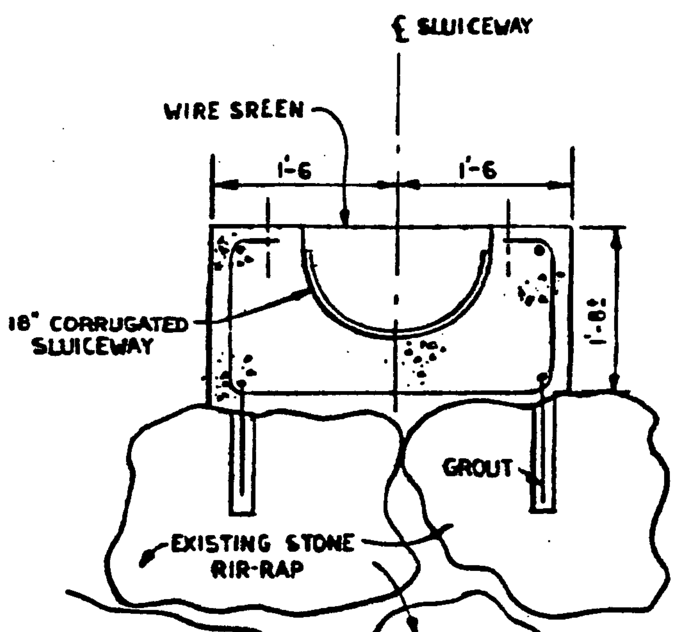
SLUICEWAY-PROFILE

VERTICAL
10 8 6 4 2 0 10
HORIZONTAL
50 40 30 20 10 0 50
SCALE IN FEET



ALTERNATE SECTION A-A

2 1 0 2
SCALE IN FEET



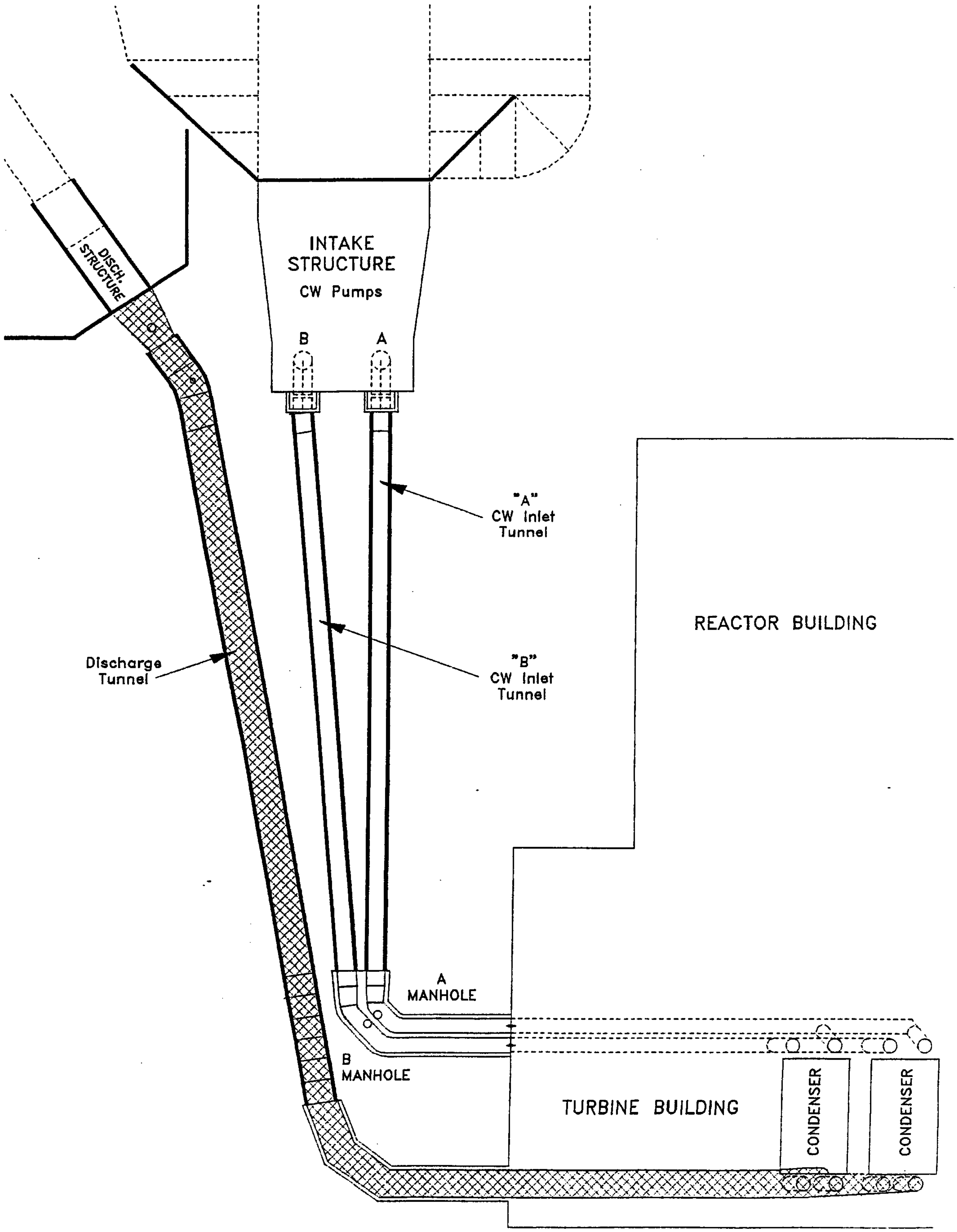
SECTION A-A

2 1 0 2
SCALE IN FEET

PROPOSED SLUICEWAY

IN CAPE COD BAY
AT PLYMOUTH MA.
COUNTY OF PLYMOUTH STATE: MASS.
APPLICATION BY BOSTON EDISON CO.

SHEET: 3 OF: 3 DATE: 8/27/79



DISCH. STRUCTURE
INTAKE STRUCTURE
CW Pumps
B
A
"A" CW Inlet Tunnel
REACTOR BUILDING
"B" CW Inlet Tunnel
Discharge Tunnel
A MANHOLE
B MANHOLE
TURBINE BUILDING
CONDENSER
CONDENSER

SLUICEWAY MODIFICATIONS – 1979

NEW SCREENWASH SLUICEWAY SYSTEM TO MITIGATE IMPINGEMENT OF FISHES AT PILGRIM NUCLEAR POWER STATION

ABSTRACT:

In late 1979 a new sluiceway system was constructed at Boston Edison Company's Pilgrim Nuclear Power Station to promote survival of impinged marine biota at the request of the U. S. Environmental Protection Agency and the Massachusetts Division of Water Pollution Control. The original sluiceway system discharged directly to a discharge canal with a Delta-T of 32°F and had a high pressure (80-100 psi) screenwash spray for removal of impinged debris and biota. The new sluiceway empties approximately 300 feet from the intake structure into ambient temperature water and a low pressure (10-20 psi) screenwash spray removes impinged biota. Impinged marine biota exposed to the original sluiceway system had minimal chance of survival due to thermal and mechanical stresses that didn't represent best available technology to the regulatory agencies. The new sluiceway system incorporates several design features that promote survival of impinged marine biota, and initial survival studies are indicative of these.

BACKGROUND:

The Pilgrim Nuclear Power Station (PNPS) is located on the northwestern shore of Cape Cod Bay. PNPS can be classified as "open coastal" with the nearest estuary being 5 miles to the north. The PNPS has two circulating water pumps with a capacity of 345 cfs each. There are also five service water pumps with a combined capacity of 23 cfs.

Cooling water passes under a skinner wall where large floating debris is intercepted, through vertical barracks spaced 3 inches on center, and finally through vertical travelling water screens of ½ x ¼ inch wire mesh. There are two travelling water screens for each circulating water pump. Current velocity approaching the screens is approximately 1 fps. The screens are rotated for spray washing several times each day, except when heavy debris loads make it advantageous to continuously rotate and wash them.

Fish impingement on the PNPS intake travelling water screens has been monitored since commercial operation began in late 1972. Average impingement rate from 1973-1980 has been approximately 2 fish/hour with 54 species of fish, 18 species of invertebrates and tons of mixed algae species being recorded. The numerically dominant species of fish sampled have been Atlantic menhaden, Atlantic herring, alewife, rainbow smelt, cunner, Atlantic tomcod, grubby, silver hake and winter flounder. Many of these fish are of commercial or sport fishery importance, or serve as forage to other species of monetary value.

In March 1979 the U.S. Environmental Protection Agency (EPA), Region 1, requested Pilgrim (then owned by Boston Edison or BECo) to investigate the feasibility of construction of a screenwash sluiceway which would discharge to ambient temperature water, far enough from the intake screens to avoid reimpingement of marine biota. BECo responded in April 1979 with a design and cost for a new sluiceway system, and also included the provisions of low pressure screenwash sprays and continuous rotation of travelling screens during high fish impingements, to promote greater survival. In May 1979 the EPA, Mass. Division of Water Pollution Control (DWPC) and Mass. Division of Marine Fisheries (DMF) approved the BECo sluiceway system design proposal, and recommended it be implemented so an operational sluiceway was in place by 1980.

SLUICEWAY DESIGN CONSIDERATIONS:

In order to maximize survival of marine biota in the new sluiceway at PNPS, design criteria were established utilizing other utilities' experience with intake screenwash sluiceways. An EEI questionnaire was prepared and distributed to numerous electric utility companies requesting information on sluiceway design and impinged fish survival at their power plants. The general consensus from the companies having the most experience in this area was that 75-80% survival of impinged fish could be achieved with a properly designed sluiceway. The following design features are important to consider for obtaining the highest possible survival of impinged biota:

1. Sluiceway Length - Short as possible to minimize the handling of organisms, but long enough to be out of intake currents' influence.

2. Sluiceway Materials - Non-abrasive material (ideally fiberglass) in contact with fish, and any coatings applied should be non-toxic.

3. Sluiceway Design

- Slope should be gradual but of enough angle to allow steady movement of material customarily carried in screenwash water.
- Discharge Point should be directly into ambient temperature water.
- Shape can be either in the form of a 'U' or 'O' for surface or underground construction, respectively. These shapes assure rounded surfaces in contact with biota which lessens potential for injury.
- Velocity should be kept below 8 fps but be great enough to prevent settling of debris that might cause a blockage of flow.
- Turbulence must be kept low by allowing adequate design dimensions for creating as laminar a flow pattern as possible.
- Bends should only be incorporated where absolutely necessary. They will cause the least problems when kept as smooth as possible.
- Depth of water of 6 inches or greater will provide adequate cushioning for most impinged biota.

4. Screenwash Water Spray - A low pressure spray nozzle system is desirable to increase survival of impinged biota. This system may be backfitted in travelling water screens, and should be designed to remove biota before they are contacted with high pressure spray primarily used to remove debris. A low pressure spray of 10-30 psi will

gently remove organisms while a high pressure spray of 80-100 psi takes care of heavy debris. Strainers installed in low pressure spray lines will help prevent clogging of headers, if unfiltered debris normally reaches them.

PNPS SLUICEWAY SYSTEM:

The above design contraints were considered in construction of the PNPS sluiceway system which became operational in February, 1980. The original PNPS sluiceway, which enters the discharge canal, is used as a debris trough during periods of coastal storms when large debris loads are handled by the travelling screens. The new sluiceway, which exits the east side of the screenhouse and discharges to the intake embayment, is used for transporting biota back to ambient temperature water. Both sluiceways utilize the original sluiceway trough running behind the travelling screens and receiving all screenwashed material. The choice of which sluiceway is used, at any given time, is made by the use of interchangeable baffle plates substituted at either end of the travelling screens' housings. Both sluiceways operate on gravity feed of screenwash water.

The new sluiceway, used for biota transport, operates when screenwash water backups up on the debris trough baffle plate and vice versa for operation of the original (debris) sluiceway. These two slucieways cannot operate simultaneously as it is necessary to have only one baffle plate installed at a time, otherwise overflowing of the trough behind the travelling screens will occur.

The original PNPS sluiceway has a trash pit with a galvanized wire basked installed in it to collect large amounts of debris. A 0.5 ton jib crane was used to hoist the basket to empty debris into a dumpster, which was then trucked offsite for disposal. This separate debris sluiceway and its method of operation prevented intake recirculation of debris and decreased the survival rate of impinged organisms: biota passing through a trash collection pit on their way back to ambient water would face a significant risk of physical harm.

The new sluiceway discharges to ambient temperature water some 300 feet from the PNPS intake structure, 5 feet below mean sea level, and out of the immediate influence of intake currents. Turns or bends in the sluiceway were kept to a minimum.

Originally, the new sluiceway was to be composed of half 18 inch corrugated metal pipe, supported by metal rods driven into stone riprap. However, because of the coastal storm exposure and high tidal amplitude at the PNPS site, a more durable concrete sluiceway design was selected. The corrugated pipe was used to form the new sluiceway as the corrugations provide the necessary resistance to flow to maintain a 6 inch water depth, and less then 8 fps water velocity in the sluiceway. Galvanized wire screen was used to cover the top of the sluiceway to preclude predation of impinged organisms by sea birds and small mammals. Heavy duty 3" grating covers the sluiceway in areas where personnel and vehicles travel over it.

In order to further increase survival potential of impinged marine biota, the high pressure screenwash sprays (80-100 psi) for the travelling screens were supplemented with low pressure sprays (~20 psi).