3.0 OVERVIEW OF CAPE FEAR POWER PLANT

3.1 Plant Description

The Cape Fear Power Plant is located in the town of Moncure which is located in Chatham County, North Carolina (Figure 3-1). The facility operates a cooling water intake structure and discharges heated cooling water back to the Cape Fear River under NPDES permit NC0003433. This permit expires on July 31, 2006, with the renewal application due January 31, 2006. Table 3-1 provides an overview of the facility and serves as a summary of relevant 316(b) factors for discussion in Sections 3, 4, and 5.

The facility has four operational units, two oil-fired combined cycle combustion turbines (Units 1 and 2, each generating 84 MW) and two coal-fired steam electric generation turbines (Units 5 and 6, each rated at 316 MW). Units 1 and 2 became operational in 1969, while Units 5 and 6 were placed in service between 1956 and 1958. Units 3 and 4 have been decommissioned and are no longer in service although the cooling water intake pumps for these units remain.

Units 5 and 6 at the Cape Fear facility are operated as baseload units and have capacity utilization rates of 62 percent and 61 percent, respectively. Units 1 and 2 are operated during periods of peak energy demand and may operate up to 100 hours per year.

3.2 Source Waterbody Description

The facility withdraws cooling water from the Cape Fear River just downstream of the confluence of the Haw River and the Deep River (Figure 3-1). The Haw River originates near Greensboro and has a drainage area of 1,690 square miles (based on USGS gage 0209800 located in Haywood N.C., approximately 1.7 miles upstream of the power plant). The Haw River (USGS Hydrologic Unit 03030002) is regulated by the B. Everett Jordan Reservoir dam, operated by the U.S. Army Corps of Engineers approximately 2.6 miles upriver. The reservoir is used for water supply, recreation, and flood control.

The Deep River (USGS Hydrologic Unit 03030003) originates near High Point and has a drainage area of 1,434 square miles (based on USGS gage 02102000 located in Moncure N.C., approximately 4.3 miles upstream of the power plant). Construction of the Randleman Dam on the Deep River approximately 55 miles upriver of the facility, first proposed in 1937 by the U.S. Army Corps of Engineers (USACE), was finally permitted in April of 2001 and construction began in August of that year. The dam is expected to reduce annual flows in the lower river at Moncure by 3 percent, but minimum release requirements will supplement natural low flows below the dam.

The estimated mean annual flow rate from the combined flows of the Haw River and Deep River at the Cape Fear facility is 2,056.4 MGD. This estimate is based on flow data at the USGS gaging station on the Deep River, Corps of Engineers flow release records for the Jordan Dam, drainage area determinations from both of the above stations to the facility's CWIS, and an average flow per square mile recommended by the USGS.

The Buckhorn dam, a decommissioned hydropower generation facility, is located approximately 5.5 miles downriver of the facility and creates a backwater pool that extends upriver of the facility. As a result, the river elevation at the intake remains fairly constant at approximately 158.5 feet. Downstream of the Buckhorn dam the Cape Fear River is controlled by a series of three locks and dams before reaching the Atlantic Ocean near Wilmington, N.C.

3.3 Cooling Water Intake System Configuration

The Cape Fear facility CWIS parallels the shoreline of the river (Figure 3-2). Vertical trash racks in a cage-like configuration (34.5 feet long, 21 feet high and projecting 5.5 feet from the bulkhead) protect two 10 foot by 8 foot sluice gates located in the bulkhead wall that parallels the shoreline. These gates can be closed to isolate the intake bay from the river. Inside the gates is a forebay area with a series of six angled vertical bar racks fronting six intake bays, three serving units 1-4 and the remainder serving Units 5 and 6. The angled bar racks can be cleaned by a railway-mounted vertical rake system. Accumulated material is washed into a sluiceway that returns the material to the river.

The CWIS utilizes five Rex-type vertical traveling screens. Screens 1, 2 and 3 (3 is fixed screen) service pumps supplying Units 1-4, and screens 5A, 5B, and 5C service pumps for Units 5 and 6. Each traveling screen is equipped with 3/8-inch square screens with 12-gauge wire, yielding a 61 percent open area. Screens 1, 2 and 3 have a width of 9.2 feet, while Screens 5A-5C have a width of 11.25 feet. The screens are single-speed with an estimated rotation rate of approximately 11 feet per minute. The traveling screens are rotated periodically based on head differential and are cleaned by a high-pressure backwash.

The height of Screens 1 and 2 is 30 feet, while the height of Screens 5A-5C is 40 feet. Each have a wetted filtering surface at normal river levels (158.5 feet) of 14.5 feet. The average design intake velocity for Screens 1 and 2 is 0.57 feet per second (fps). The average design intake velocity for Screens 5A-5C is 1.56 fps.

As detailed in Table 3-1, the total cooling water system design capacity is 298,600 gallons per minute (gpm), or 429.984 million gallons per day (MGD). This represents approximately 20.9 percent of the mean annual river flow. Based on five years of operational records from the facility's Discharge Monitoring Reports, actual flows based on annual monthly average flows using circulating pumps for Units 1, 2, 5, and 6 average 143,540 gpm (206.7 MGD), or 10.1 percent of mean annual river flow.

Design intake flows in rivers of greater than 5 percent of annual mean flow make the facility subject to the entrainment performance standard, thus the Cape Fear facility is subject to this standard.

Table 3-1 Cape Fear River Plant Cooling Water Pumping Capacity

Pump	GPM	MGD
1E	15,000	21.6
1W	15,000	21.6
2E	15,000	21.6
2W	15,000	21.6
3 *	30,500	43.92
4 *	30,500	43.92
5A	40,800	58.752
5B	40,800	58.752
6A	48,000	69.12
6B	48,000	69.12
Totals	**298,600**	**429.984**

* Units 3 & 4 have been retired although respective pumps remain

The once-through cooling water is discharged into a canal built to provide additional heat dissipation prior to return to the river. It has been extended several times during the facility's operational life, and currently is approximately 30,000 feet long. The discharge is returned to the river approximately 800 feet upstream of the Buckhorn Dam.

Mechanical draft cooling towers have been constructed adjacent to the discharge canal on the facility property (Figure 3-2). An intake on the discharge canal is used to pump water up into the towers. Water in the collection basin can be returned to the river intake forebays via a 10-foot diameter reinforced concrete underground pipe or discharged back to the discharge canal. Sluice gates at the river intake can be closed to operate in a recirculating mode, or the cooling tower can operate in an open-cycle mode.

3.4 Cooling Water Intake System Operation

The three screens that service baseload Units 5 and 6 operate automatically in response to head differential across the screens. Screen backwash water is collected in a trough and routed to a metal sluiceway that returns the backwash water and associated material to the river downstream of the intake.

The intakes for Units 1 and 2 are operated in a similar fashion when these units are operated in combined cycle mode, however these units are typically used in simple cycle mode and thus do not generally utilize cooling water. However, the pumps are used to provide dilution water for cooling the condenser cooling water during periods before and after use of the open-cycle cooling towers.

The cooling towers are typically operated in open-cycle mode to meet the NPDES temperature limit of 32°C (89.6°F), generally during the months of May through September. When operated in closed-cycle mode, makeup water requirements from the river are significantly reduced and range from 24 to 28 MGD.

3.5 Area of Hydraulic Influence

The Cape Fear facility intake's area of hydraulic influence was estimated using the cooling system's design pump capacity (430 MGD), the design capacity with Units 3 and 4 decommissioned (342 MGD) as well as the 206.7 MGD average intake flow for the past five years. The analysis assumed a constant intake rate over time for each flow scenario, and that the intake area was appropriately represented as two 10-foot wide sluice gates that are each 6.5-feet high, the normal operating height of the gates. The calculation process also assumes a radial influence for drawing water into the intake from the river.

The first step in determining the area of influence entailed calculating the ambient velocity of river flow past the gates. Bathymetric cross-sections of the river in the vicinity of the intake were used to estimate an average river depth (d) of 11 feet at the intake and a width of 300 feet. This represents a cross-sectional area (A) of 3,300 square feet across the river at the intake location. Using an annual average flow condition (Q) of 3,187 cubic feet per second (cfs) based on USGS data, the average ambient river velocity (v) past the intake gates is approximately 0.97 ft/sec ($v=Q/A$).

The area of hydraulic influence was calculated based on the circumference of the area around which the required volume of water is radially drawn into the intake system using the stream geometry and flow dynamics described above. These volumes equal the ambient stream velocity (or "length" of water passing through the river cross-section per unit time) multiplied by the channel depth, multiplied by the circumference or perimeter from which the required water is drawn into the system:

$V = v * d * C$. Thus, $C = V/(v*d)$

The area of hydraulic influence, measured as the radial distance outward into the river channel from the intake gates, is measured as the radius (R) of the semicircle of the shoreline intake per unit time:

$R = C/\pi$

Based on this approach, the area of hydraulic influence for the design intake capacity scenario (V_1 = 430 MGD) reaches approximately 20 feet into the river channel from the intake gates. The area of hydraulic influence for the design flow with units 3 and 4 decommissioned (V_2 = 342 MGD) extends approximately 16 feet into the river channel. The area of hydraulic influence for the 206.7 MGD scenario (V_3) extends approximately 10 feet outward into the river channel from the intake gates.