AmerGen.
An Exelon Company

DETERMINATION OF COOLING TOWER AVAILABILITY

for

Oyster Creek Generating Station
Forked River, New Jersey

FINAL REPORT

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AMERGEN ENERGY COMPANY, LLC

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Exelon Corporation, through its company AmerGen, retained URS Corporation (URS) to evaluate and document the availability of cooling tower technologies as an appropriate technology at the Oyster Creek Generating Station (OCGS). Such an analysis is appropriate under Section 316(b) of the Clean Water Act and the Unites States Environmental Protection Agency's Phase II Rule regulating compliance with Section 316(b). This report was written with the intended audience being the permit writer and is not intended as a detailed design engineering report. URS relied upon previous cooling tower studies, drawings, and design data to develop a conceptual model for the construction and operation of cooling towers at OCGS. The conceptual model was updated to account for new technologies, site conditions, environmental impacts, and regulatory requirements. The conceptual model incorporates the most efficient and cost-effective technologies currently available to meet the requirements of the Rule, minimize environmental effects that are expected to arise from the use of cooling towers, and meet the energy demands of New Jersey and the region.

The conceptual model is a recirculating closed-cycle cooling system that consists of two multi-cell mechanical draft hybrid cooling towers. A hybrid cooling system, which is a combination of wet evaporative cooling and dry cooling, was chosen because of the need for both consumptive water use reduction and plume abatement at this particular site. It is paramount that the newly implemented security systems at OCGS not be hindered by either an elevated plume or ground fog. A hybrid system can effectively eliminate a visible plume and ground fog at a lower cost and using less land area than air-cooled condensers. The reduction or elimination of a visible plume is, by necessity, the driving factor in the design of any cooling system at OCGS.

Other plant design and operational parameters that constrained the conceptual model are: nominal unit output; condenser heat load; cooling water flow; temperature increase across the condenser; ambient wet bulb temperature; cooling tower temperature range; approach temperature; drift; number, size and type of pumps; wind direction; noise; seismic, freeze, corrosion, and lightning protection; method of cleaning the cooling tower basin; and make-up water source.

The conversion of the existing once-through cooling system to a closed-cycle system would include the construction of two multi-cell mechanical hybrid fiberglass cooling towers arranged in two rows, two new cooling tower basins, two new cooling water pump houses, two new 12-foot diameter pipelines to convey circulating water to and from the cooling towers, and interconnections between the existing cooling water supply and discharge tunnels with the new circulating water conduits. OCGS' newly implemented security measures also would need to be modified.

After substantial completion of the new cooling towers and circulating water system, a minimum outage of at least 150 days would be required to interconnect the new system with the existing circulating water distribution system of the once-through cooling system. Once the changeover is completed and the system is fully functional, URS estimates OCGS would have an annual net average reduction of 32.5 MW of electric power.

Regulatory and Environmental Issues

The design basis for the conceptual model sought to minimize environmental impacts. AmerGen would do whatever it can within reason to meet applicable environmental regulatory requirements, however, numerous conflicts were identified. These are:

- New Jersey Department of Environmental Protection (NJDEP) Coastal Area Facility Review Act (CAFRA) Permit - CAFRA imposes an impervious surface cover limit on the site. The construction of the conceptual model may not meet the CAFRA impervious surface limit. AmerGen would do whatever is required to meet applicable regulations, but because of CAFRA, the total site area may be insufficient to accommodate the additional impervious area that would be necessary for the towers to be built.

- NJDEP/USEPA Prevention of Significant Deterioration (PSD) Preconstruction Permit – Despite the fact that the selected conceptual model incorporates the most efficient drift eliminator technology available, the PSD ambient air quality particulate matter increments, the National Ambient Air Quality Standards (NAAQS), and New Jersey Ambient Air Quality Standards (NJAAQS) may not be met. A screening analysis of the impact of PM10 indicates that PSD increments, NAAQS, and NJAAQS would not be achieved. AmerGen would do whatever it can to meet PSD, NAAQS, and NJAAQS requirements. However, if the air quality requirements are not met, cooling towers cannot be built and operated.
- PSD requirements for Class I Areas – More stringent Class I area PSD requirements would need to be met at the Brigantine National Wildlife Refuge (approximately 25 miles south of OCGS) than in the Class II area that surrounds the plant. OCGS' air emissions would need to be reviewed and approved by the National Park Service.
- Based on average emissions rates at existing fossil-fuel fired electric generating facilities in New Jersey, increases in air emissions to replace the lost generation at OCGS would be:
  - CO_2: 218,308 tons per year
  - SO_2: 501 tons per year
  - NO_x: 356 tons per year
  - CO: 1134 tons per year
  - PM10: 807 tons per year
- Increases in air emissions at fossil-fuel fired plants that would be needed to replace the lost generation at OCGS would range from 478 to 3140 tons per year of sulfur dioxide and from 300 to 1495 tons per year of nitrogen oxides.
- Increases in cooling water usage at fossil-fuel fired plants replacing the lost generation at OCGS would be 32.5 million gallons per day.
- Lacey Township Zoning – The current power station is a nonconforming use and its expansion would require variances for land use and fences. Visual, noise, and traffic impacts may prevent this project from receiving these variances. AmerGen would do whatever it can to acquire township variances. However, if the required variances are not obtained, cooling towers cannot be built and operated.
- 316(b) Performance Standards
  - There would be a very small improvement in reducing the mortality of impingeable-size organisms. The National Performance Standard for impingement mortality (80 to 95 percent reduction) of impingeable-size organisms may not be achieved with the selected conceptual model.
  - Flow reduction with the selected conceptual model would be significantly less than what would be expected from a closed-cycle cooling system that uses fresh water.

Financial Analysis

The United States Environmental Protection Agency's (USEPA) estimated 316(b) compliance costs at OCGS are $11.2 million per year ($4 million for the cooling water intake structure and $7.2 million for the dilution water intake) annualized over a 10-year period, or a net present value (NPV) cost of $79 million.

The estimated NPV capital and operating costs of the selected conceptual model for cooling towers at OCGS are between $705 million and $801 million over the same 10-year period.[1]

The factors considered in the cost estimates of this study include construction (materials and labor), lost capacity/energy revenue during construction, environmental permitting, real estate taxes, cost of modifying OCGS' Master Plan, added security and plant operation personnel, added insurance, maintenance, chemicals, and a contingency factor for unforeseen events. These costs do not include allowance for funds used during construction (AFUDC or the estimated debt and equity costs of capital funds necessary to finance construction), allowance for startup, allowance for spare parts, working capital or inventory capital, allowance for client engineering and management, assessment of the costs of replacement power during construction, royalties, Exelon's internal labor costs, outside legal counsel, and additional construction-period security personnel.

Under the final Phase II USEPA regulation, the applicable standard for assessing the costs of compliance is whether the cost is "significantly greater" than USEPA costs. The costs to comply by installing a best technology available cooling tower system at OCGS are significantly greater than USEPA costs as well as wholly disproportionate.

Conclusions

Considering the regulatory issues that must be resolved prior to construction, the complexities of construction, and the potential disruptions in vital safety-related systems at a nuclear plant, the time to implement a cooling tower alternative at OCGS would be lengthy. AmerGen would make every effort to expedite the regulatory process. However, AmerGen has no control over the politic process and the politics that could affect approval. It may not be possible to receive the air quality permits and local variances needed to build the cooling towers.

URS concludes that the option to construct a closed-cycle recirculating cooling water system is not available at OCGS under the Phase II Rule because the system will be lengthy and difficult (or even not possible) to permit, and the estimated cost is significantly greater than those considered by USEPA. OCGS achieves, or nearly achieves, the national performance standards with currently implemented measures. Based on the conclusion that cooling towers are unavailable at OCGS, the facility should optimize the existing system to achieve the greatest efficacy as practicable by implementing operational controls/flow reduction at the dilution pumps and performing habitat restoration.

[1] These figures are a more accurate estimate of the cost to install cooling towers at OCGS than the estimated costs provided in the OCGS Proposal for Information Collection (PIC) (June 2005). The PIC reported (in 2002 dollars) the results of a previous preliminary evaluation. The PIC did not conduct a detailed analysis such as the one conducted for this report.

Section 316(b) of the Clean Water Act directs the United States Environmental Protection Agency (USEPA) to ensure that cooling water intake structures reflect the best technology available (BTA) for minimizing adverse environmental impacts to aquatic organisms caused by entrainment and impingement. The Phase II Rule (the Rule) implementing Section 316(b) at Oyster Creek Generating Station (OCGS), a nuclear-fueled base-load 641-MW boiling water reactor located in Lacey Township, Ocean County, New Jersey, establishes national technology-based performance standards for impingement mortality and entrainment.

The USEPA determined that a closed-cycle, recirculating cooling system (e.g. cooling towers or ponds) *"would always achieve the performance standards and therefore, facilities that reduce their flow commensurate with closed-cycle, recirculating cooling systems are deemed to have met performance standards" (69FR41601, col. 3). At the same time, USEPA also "determined that this technology is not economically practicable for many existing Phase II facilities"* (69FR41601, col. 3).

AmerGen retained URS Corporation (URS) to evaluate and document whether closed-cycle, recirculating cooling system technologies are available at OCGS in accordance with the Rule. This report was written with the intended audience being the permit writer and is not intended as a detailed design engineering report. This report is an Appendix to the Comprehensive Demonstration Study (CDS) undertaken in compliance with the Rule. The initial component of the CDS, the Proposal for Information Collection, was previously submitted to the New Jersey Department of Environmental Protection (NJDEP). The information provided in this report will be used in the CDS technology evaluation. It provides the basis of our determination that cooling towers are unavailable at OCGS and, therefore, other technologies and measures need to be addressed in the CDS.

URS determined, at the outset of this investigation, that a cooling pond system could not be constructed at OCGS. A cooling pond with an effective cooling area of 1,500 acres would be needed for OCGS. This land area is not available at the site. Therefore, this report only focuses on cooling tower technologies.

1.1 METHODOLOGY

URS relied upon previous studies to initially develop a conceptual model for the construction and operation of a closed-cycle circulating cooling system at OCGS. These studies included EBASCO's *Update of Alternate Cooling Water System Study for Oyster Creek Nuclear Generating Station (1992), an update of a 1977 EBASCO report,* and Stone & Webster's *Closed-Cycle Cooling (1999),* a report prepared for the Salem Generating Station on Delaware Bay. Based on these studies, and available drawings and design data for OCGS acquired through site visits to the station and meeting with plant personnel, URS formulated a design basis for a preliminary conceptual model.

The design development progressed through these steps:

- Select cooling tower type and size
- Determine cooling tower location and cooling water system (CWS) configuration
- Determine CWS tie-in logistics and necessary modifications to the circulating water tunnels and structural components, with minimum impact to plant operation
- Select and size the circulating water pumps and piping systems
- Select the route the new water pipelines and relocate existing services in affected areas
- Evaluate electrical loads and establish power requirements
- Assess security issues

- Evaluate environmental impacts and regulatory requirements
- Estimate construction and operating costs

The preliminary conceptual model was modified to account for new technologies, site conditions, environmental impacts, regulatory requirements, and costs. The selected conceptual model incorporates the most efficient and cost-effective technologies currently available to meet the requirements of the Rule, minimize attendant environmental effects not currently present, and meet the energy demands of New Jersey and the region.

1.2 REPORT ORGANIZATION

This report describes the decision factors applied in the process of selecting a final conceptual model for OCGS. Report chapters address these topics:

- Section 2.0 –Describes the existing plant cooling system configuration (once-through open cycle) and discusses cooling tower technologies (recirculating closed-cycle).
- Section 3.0 –Presents the design choices and the rationale for design selections.
- Section 4.0 – Describes the selected conceptual model and impacts to the plant, including costs.
- Section 5.0 – Discusses Federal, state, and local regulatory requirements
- Section 6.0 – Determines cooling tower unavailability
- Section 7.0 – Lists conclusions
- Section 8.0 – Lists references cited in the report

This chapter briefly describes OCGS' existing once-through cooling water system and then describes various cooling systems that operate with cooling tower technologies.

2.1 EXISTING ONCE-THROUGH OPEN-CYCLE COOLING SYSTEM AT OCGS

OCGS uses a once-through open-cycle cooling system to remove heat and condense the Main Turbine exhaust steam in the station's three main condensers. Once-through open-cycle cooling systems of this type pump a large volume of cooling water directly from a relative large body of water through a steam condenser to remove heat and condense the steam exhausted from the Main Turbine. The warmed cooling water is then discharged back to the waterbody, and the condensed steam is pumped to the reactor vessel to continue the steam cycle. Virtually the entire heat load from condensing the steam is transferred to the source waterbody with very little heat immediately dissipated to the atmosphere.

The system at OCGS consists of a circulating water intake structure with Ristroph screens and a fish handling system, and a separate dilution/bypass water intake structure, which are supplied by an intake canal created by modifying portions of the South Branch of the Forked River. OCGS is located adjacent to U.S. Route 9, about two miles west of Barnegat Bay. The source waterbody for the intake canal is Barnegat Bay and the intake and dilution structures are approximately 0.25-mile west of U.S. Route 9.

The circulating water system is designed to supply a continuous flow of cooling water to remove waste heat. The system also provides an alternate or supplementary supply of cooling water to the turbine building cooling water heat exchangers. The dilution/bypass water is used to temper the thermal discharge from the circulating water system to minimize the resultant increase in water temperature in the discharge canal and ultimately in Barnegat Bay. Cooling water from the condensers is mixed with the outflow of ambient temperature water from the dilution pumps prior to being returned to Barnegat Bay via a discharge canal created by modifying portions of Oyster Creek.

In addition, the circulating water and dilution/bypass systems is used when required to ensure that the minimum required discharge canal flow is maintained during the release of liquid radioactive effluents in accordance with the station's operating license from the United States Nuclear Regulatory Commission (NRC).

The facility uses a General Electric Boiling Water Nuclear Reactor with a General Electric Steam Turbine consisting of one dual-flow high-pressure steam turbine and three dual-flow low-pressure steam turbines. Each of the low-pressure turbines is supplied with a non-contact shell-and-tube condenser that is used as a heat sink for the exhaust steam from the Steam Turbine.

The hot exhaust steam from the low-pressure turbines is condensed as it flows past the outside surfaces of thousands of cold tubes in the condenser. The tubes contain cold circulating water that removes heat and condenses the steam, creating a vacuum in the condenser. The exhaust steam needs to be condensed so it can be returned to the Reactor via pumps, where it is boiled to supply steam to the Main Turbine to repeat the cycle. For steam turbines, the lower the operating exhaust vacuum pressure (back pressure) obtained from the condenser system, the greater the power produced.

Circulation water is provided to the condenser by four large circulating water pumps. Each pump's capacity is 115,000 gallons per minute (gpm), and with all four pumps in operation approximately 460,000 gpm of circulating water passes through the condenser. The temperature of the circulating water exiting the condenser is approximately 20°F warmer than when it entered the condenser, and it is mixed with dilution water as it is directed into the discharge canal. The dilution water, which is at ambient temperature, is directly pumped from the intake canal to the discharge canal by two of three 260,000 gpm capacity pumps for a total flow rate of 520,000 gpm. The total combined intake and discharge flow rate is approximately 980,000 gpm. At times during the coldest months of the year, only three of the four circulating water pumps are required.

2.2 COOLING TOWER SYSTEMS

The heat that is removed from the exhaust of a low-pressure steam turbine is normally transferred to a water heat sink or to an air heat sink using one of these three processes:

1. Wet Evaporative Cooling
   - Wet evaporative cooling system in a closed-cycle configuration
   - Open-cycle cooling system as presently used at OCGS
2. Dry Cooling
3. Hybrid Cooling

The remainder of this section includes a brief description of low-pressure steam turbine condensing systems that use these three processes.

2.2.1 Wet Evaporative Cooling

A wet evaporative cooling system is a circulating water system where cooling water is pumped in a closed-cycle from a cooling tower basin directly to the steam condenser and back to the cooling tower where excess heat is dissipated to the atmosphere (Figure 1). The efficiency of the heat transfer processes is enhanced in the tower by the addition of spray nozzles, splash bars, or film fill. The final outflow water temperature in the basin depends on several factors, including the relative humidity of the ambient air temperature, the station's heat load, the cooling efficiency and the design of the cooling tower.

Wet evaporative cooling towers dissipate heat through evaporation. The evaporated water is replaced by adding makeup water to the cooling water system. Makeup water compensates both evaporation losses and the blowdown from the cooling system. Blowdown is used to manage the chemistry of the circulating water.

There are two generic types of wet evaporative cooling towers: natural draft and mechanical draft.

- Natural draft towers operate on a principal of buoyancy. The heated less dense air will rise through the tower stack and disperse into the cooler denser atmosphere. These towers have a distinctive hyperbolic chimney design.
- Mechanical draft towers use fans to force air through the tower. The fans can be at the base of the tower to force air upward against water cascading down (forced draft, countercurrent flow) or, at the top of the tower to draw air up against water cascading down (induced mechanical draft, countercurrent flow). Cross-flow towers have fans that draw air through the sides of the tower rather than its base.

2.2.2 Dry Cooling

A dry cooling system uses air to transfer heat directly from the condenser outlet to the atmosphere (Figure 2). Dry cooling systems may be direct or indirect. This type of cooling system is used primarily in arid areas where:

- Cooling water is not available;
- Cooling water is extremely limited and conservation is critical; or
- Unacceptable aquatic impacts may occur.

A direct dry cooling system uses an air-cooled steam condenser where the turbine exhaust steam is piped directly through bundles of finned tubes. The tubes are arranged in the form of an A-frame or delta to

reduce the required land area. Condensed water flows downward in the tubes and is collected at the bottom of the bundles and forwarded to the steam generator as feedwater supply.

In an indirect dry cooling system (Heller system), steam from the steam-turbine generator is first condensed in either a surface or direct contact jet condenser using cooled water supplied from a dry cooling tower. Warmed water from the condenser is pumped in a closed loop circuit back to the dry cooling tower. A percentage of the cooling water is supplied as feedwater supply into the steam turbine steam.

2.2.3 Hybrid Cooling

A hybrid cooling system is a combination of a wet evaporative cooling system and a dry cooling system (Figure 3). This system is commonly used in applications that require plume abatement, or some reduction in consumptive water use. Hybrid systems can be configured in parallel or in series.

In the series configuration, all of the exhaust steam from the turbine is condensed in a conventional water-cooled surface condenser. This system is essentially a wet evaporative cooling system. There is sufficient dry cooling surface area so that the outlet state point from the combined effluents of the wet and dry sections falls below air saturation point. As a consequence, a visible plume does not form.

In the parallel configuration, the exhaust steam is condensed in both a surface condenser and in a direct air-cooled condenser.

Three potential cooling tower systems were described in Chapter 2.0 (wet evaporative cooling, dry cooling, and hybrid cooling). This chapter discusses the rationale for selecting specific features that became components of the conceptual model for hypothetical cooling towers at OCGS. Section 3.1 provides the design basis. The rationale behind the selection of this design basis is discussed in detail in Section 3.2. Finally, Section 3.3 presents specifications for the design parameters incorporated into the conceptual model.

3.1 DESIGN BASIS

The operating scenario considered in this study is a full-capacity closed-cycle cooling tower in full-time (24-hour) operation. The major plant design and operational parameters constraining the conceptual model are:

- Nominal unit output = 641 megawatts of electrical output (Mwe)
- Condenser heat load = 4.47 billion British thermal units per hour (or 4470 MMBTU/hr)
- Circulating water system flow = 460,000 gallons per minute (gpm)
- Ambient wet bulb temperature = 77 degrees Fahrenheit (°F)
- Dry bulb temperature = 87°F
- Cooling tower range = 20°F
- Approach temperature = 9°F
- Drift - 0.0005% of circulating water flow
- Number of cooling towers - two cooling towers with 18 cells each
- Tower type - mechanical, hybrid, fiberglass construction
- Number of pump houses = two
- Number of circulating water pumps = four
  - Four variable speed pumps in one pump house (rated at 115,000 gpm each)
- Number of cooling tower lift pumps = four
  - Four variable speed pumps in one pump house (rated at 115,000 gpm each)
- Number of makeup pumps = two (plus one spare)
- Three constant speed pumps rated at 10,000 gpm each
- One dilution pump
- Cooling tower location – north of station
- Wind direction coincident with high wet bulb temperature = 250° (west southwest) at 11 miles per hour
- Noise requirements – as necessary to comply with township ordinances
- Features for freeze protection –
  - Air-side (freeze protection is by fan shut down)
  - Water-side (freeze protection is by tower bypass)
- Fan speed – single speed fans
- Lightning protection

- Fire protection to meet Nuclear Electric Insurers Limited property loss control standards
- Lighting
- Stairway and hand rails
- Method of cleaning the cooling tower basin
  - Basin sump pit with clean-out drain and overflow or sump pump
- Method of makeup –
  - Makeup will be from the intake canal through the existing intake structure and circulating water pumps
- Seismic requirements - in accordance with Building Officials and Code Administrators building codes

3.2 DESIGN RATIONALE

The 1992 EBASCO report evaluated two cooling tower designs at OCGS: natural draft cooling towers and round mechanical draft cooling towers. URS initially contacted two major cooling tower vendors (GEA and SPX Cooling Technologies [Marley]) and asked about the status of the types of towers recommended in the EBASCO study, as well as a "generic" linear mechanical draft evaporative cooling tower. URS considered other cooling tower alternatives after discussions with plant personnel regarding their profound concern regarding security requirements imposed at the nuclear plant and the need to eliminate a visual plume and maintain clear lines-of-sight. The reduction or elimination of visible plumes are, by necessity, a driving factor in the design of the conceptual model. Thus, in total, six types of cooling towers were investigated. These are:

1. Natural draft
2. Linear mechanical draft
3. Round mechanical draft
4. Dry air-cooled
5. Linear hybrid
6. Round hybrid

Table 1 presents a comparison of the design parameters of five of the six tower types. The remainder of this section provides a summary of the major design issues.

3.2.1 Cooling Tower Options

This subsection contains the rationale behind the selection of cooling tower type.

3.2.1.1 Natural Draft Cooling Tower

Both vendors stated that they could design and provide engineering assistance for a natural draft tower from their European subsidiaries. The vendors explained that this type of tower, although seen at a number of nuclear and large fossil power plants, have not been constructed in the United States for over twenty years. They indicated that the expertise for engineering and construction of these towers exists in Europe but not in the United States. One vendor suggested that the concrete pouring slip forms that used to exist in the United States may no longer be available and expressed doubt regarding the ability of a construction company to provide experienced project managers to undertake the construction of the tower shells.

URS asked the vendors to provide the relative costs of different tower designs with respect to a base cost of a rectilinear forced draft evaporative cooling tower. One of the vendors suggested that the installed cost is approximately 2½ times the base cost of a linear mechanical draft evaporative cooling tower. The second vendor stated they would not even venture to provide a cost or the man-hour effort required to construct a natural draft cooling tower.

The EBASCO report provides a visual assessment of a single 400-foot base diameter by 600-foot tall natural draft cooling tower at the OCGS site. Appendix A reproduces the EBASCO visual analysis. As shown, this type of cooling tower would dominate the local landscape, and would be visible perhaps to distances of up to three miles. While the potential for ground fogging would be eliminated because of the height of the tower, there is the potential for a longer range of salt drift from the plume because the water being evaporated has concentrated saline water.

URS eliminated the natural draft cooling tower from consideration mainly because of the significantly higher price, problems with constructability of this type of tower in the United States, construction issues related to the ability of the soil to support the weight of a structure of this magnitude, permitting problems (local zoning), and public perception from its dramatic visual impact (see Appendix A).

3.2.1.2 Linear Mechanical Draft Evaporative Cooling Tower

Rectangular linear mechanical draft cooling towers are made of individual tower cells arranged in-line or back-to-back. The in-line arrangement is approximately half as wide and twice as long as the back-to-back arrangement and has the advantage that air can be drawn in both sides of the cell. However, the plume from a rectangular linear mechanical draft cooling tower is more vulnerable to ground fogging and potentially ground icing at certain atmospheric conditions.

A rectangular linear mechanical draft cooling system was the primary unit under consideration because it is the most common closed cooling system used for power plant heat rejection and, therefore, has the lowest base price compared to the other types of towers. URS sent design criteria to the vendors to supply budgetary pricing and operating parameters. Their pricing of a rectangular linear mechanical draft cooling tower at OCGS was used to calculate the base design cost that is shown in Table 1.

3.2.1.3 Round Mechanical Draft Evaporative Cooling Tower

A round mechanical draft tower presents a concentrated center plume that provides buoyancy to elevate the plume higher than a linear mechanical draft evaporative tower (although not as high as a natural draft tower). The elevated plume reduces ground fog and icing better than the linear tower, but does not eliminate either the fog or the ice.

Only one of the two vendors that URS contacted is capable of providing a round mechanical draft tower. They estimated that it has an installed pricing of approximately two times the cost of a linear mechanical draft evaporative cooling tower. The second vendor indicated that with the round mechanical draft tower the plume is entrained back into the cooling section reducing the effectiveness of the tower.

URS eliminated the round mechanical draft cooling tower because of ground fogging/icing and cost.

3.2.1.4 Round Mechanical Draft Wet-Dry Hybrid Cooling Tower

The same vendor who stated that they could provide the round mechanical draft evaporative cooling tower was also contacted regarding a round hybrid tower design. Although a round hybrid tower was supplied to a European utility, it was very expensive and is not currently being offered anywhere. Thus, URS also eliminated the round mechanical draft wet-dry hybrid cooling tower.

3.2.1.5 Dry Cooling Tower with Air-Cooled Condenser

While a tower with a dry air-cooled condenser system will eliminate a visible vapor plume (fog) this type of tower covers an extremely large land area and would require a total reconfiguration of OCGS' turbine exhaust system including the complete removal and redesign of the three shell-and-tube Main Condensers. There is no known conversion of a large unit, such as OCGS, from an open- or closed-cycle cooling system to an air-cooled condenser system.

The cost of the air-cooled condenser alone, not including the redesign of the condensers and running extremely large vacuum pipes to each of the three Low-Pressure Turbines, is approximately six times the base tower cost (Table 1). This type of tower also has the largest sound signature (i.e., is the loudest design) of all the options that URS considered.

URS eliminated a dry air-cooled condenser system because of the acreage required, the technical obstacles of the conversion, high noise levels, and the extremely high price.

3.2.1.6 Linear Mechanical Draft Wet-Dry Hybrid Cooling Tower

A hybrid design can control or eliminate ground fog. The wet evaporative section of the hybrid tower is essentially the same design as the "base" mechanical draft evaporative cooling tower. A dry section is added to the top of the main tower. During seasons when fogging is least likely to occur (spring, summer, and fall) the tower operates as a conventional mechanical draft evaporative cooling tower. During time periods when fogging is likely to occur (winter) the tower is operated in a combined mode with the dry section adding heat to the exhaust plume to dissipate the visible fog.

The pricing of the linear hybrid tower ranges from two to three times the cost of a linear mechanical draft evaporative cooling tower. Both vendors provided URS with budgetary costs and performance information.

A hybrid tower became a prime candidate because of its effectiveness in reducing a visible plume.

3.2.2 Selection of Cooling Tower Type

Table 1 summarizes the items that URS considered in selecting the appropriate cooling tower type at OCGS. As previously discussed, it is paramount that the newly implemented security systems at OCGS not be hindered by either an elevated plume or ground fog. The reduction or elimination of a visible plume is, by necessity, the main driving factor in the design of the conceptual model.

Although dry air-cooled towers would not produce a visible plume, this type of cooling system was eliminated because of the large land area required, technical obstacles of the conversion, and the extremely high price (the most expensive of all of the systems reviewed). Natural draft towers were also eliminated because of the great visual impacts of its massive 600-foot high tower (the tallest of all the systems reviewed), public perceptions and zoning, the need for an extensive foundation with associated additional costs, potential delays, overall cost, and the added fact that this type of tower has not been built in the United States in over two decades. Consequently, a mechanical draft system was pursued.

Although mechanical draft towers eliminate some of the problems of natural draft towers, visible fog plumes are inherent in each design. The round mechanical towers also have recirculation problems. Thus, it was realized that the best approach was to combine the best properties of a linear mechanical draft system (e.g., low cost, reduced land area, reduced tower height) with the advantage of a dry air-cooled system (fog abatement). These goals can be achieved with a hybrid system.

A hybrid system can effectively eliminate a visible plume and ground fog at a lower cost and using less land area than air-cooled condensers. A hybrid configuration was not widely available at the time of the

EBASCO report. The hybrid system is a more modern overall cooling tower system technology that can be optimized to meet the special needs of OCGS, that is, to reduce both consumptive water use and limit visible plumes.

For these reasons, URS chose a hybrid system as the optimal cooling tower type for OCGS. The next step was to develop the design specifics. The following sections discuss how these were developed and incorporated into the conceptual model.

3.3 DESIGN PARAMETERS

This section presents the specifications for the design parameters that URS incorporated into the conceptual model.

3.3.1 Size

The parameters that determine cooling tower size consist of range, approach, and circulating water flow rate. The range is the difference between the outlet water temperature and inlet water temperature. The approach is the difference between the outlet water temperature and the design wet bulb temperature. The circulating water flow is the flow through the cooling tower. The existing equipment at OCGS sets the range and circulating water flow rate. These factors are discussed further in Section 3.3.3.

3.3.2 Material

Mechanical draft towers typically are constructed of wood or fiberglass material. A wooden cooling tower is prone to deterioration if it is exposed to dry/wet cycles from part-time operation. Wood towers are also subject to leaching of heavy metal chemicals in the wood preservative. Due to the range of circulating water flow rates caused by the number of cells in operation, fiberglass is the preferred construction material. Fiberglass towers allow cells to be out of service and avoid the problem of wood deterioration.

3.3.3 Thermal Design

The two thermal design conditions for the hybrid system are:

- evaporative only mode (summer)
- combined mode (winter)

URS chose summer design ambient conditions that, according to the PJM summer capability rules, *"reflect the ... median of temperature and humidity conditions at the time of the PJM summer peak load ... for the past 15 years."* ("PJM Manual for Rule and Procedures for Determination of Generating Capability," Manual M-21, Rev 01 Aug 23, 2000; Section 1.2.2] For the winter design conditions, URS used similar criteria, but at a 60 percent humidity that would cause a fog plume to form.

There are two other factors that affect the overall size and plant performance of an evaporative cooling tower system: the circulating water range and the cooling tower approach temperatures.

3.3.3.1 Circulating Water Range

The circulating water range is the temperature difference between the cooler circulating water that enters the condenser and the warmer outlet water. The higher the circulating water flow, the smaller the temperature range that is required for constant heat dissipation from the condenser. The size of the cooling tower varies inversely with the temperature range. However, higher pumping power is required to deliver the flow through the closed circuit.

The velocity of the water that flows through the condenser tubes sets the design flow rate through the condenser. The optimum velocity of water within the condenser tubes is between 5 and 10 feet per second (fps). Upon review of the existing condenser data sheets, URS found that the design conditions included a water velocity of approximately 7 fps with a temperature range of slightly less than 20°F.

Based on this design information and the standard requirements for an evaporative cooling tower, URS determined that the existing condenser design is suitable for evaporative cooling tower duty from a thermodynamic perspective. Because the number and diameter of the tubes would not be changed, and the original design velocity is within the optimal flow speed at (7 fps), URS set the circulating water flow rate to be essentially the same as OCGS' existing open-cycle cooling system (460,000 gpm).

3.3.3.2 Approach Temperature

The approach temperature is the difference between the ambient wet bulb temperature and the temperature of the cooled water that is conveyed from the cooling tower to the condenser. The ambient wet bulb temperature is the dew point of the air, or the temperature at which air is saturated with water vapor that condenses to produce water (dew). Thus, the ambient wet bulb temperature represents the coldest temperature to which water can be cooled by passing it through the air. The design wet bulb temperature of a tower is a function of the climate at the tower location. For OCGS, the design wet bulb temperature at the 0.4 percent coincidental occurrence is 77°F with an 87°F dry bulb temperature.

The physical size of the cooling tower is inversely proportional to the approach temperature. As the approach temperature is reduced, the cooling tower size required increases exponentially, becoming asymptotic to an approach temperature value of 0°F. The cooling water temperature at the inlet to the condenser at the summer design point is the sum of the ambient wet bulb and the approach temperatures.

When the temperature of the inlet water to the condenser increases, power generation is reduced because the exhaust pressure of the steam turbines increases. To generate as much electricity as possible, especially in the summer, the backpressure needs to be as low as possible. A lower backpressure generally can be achieved when the temperature of the inlet water to the condenser is lower.

Based on 15 years of plant history, the existing open-cycle intake water temperature for the days of the PJM summer peak load averages 83.7°F. To obtain a similar inlet circulating water temperature from an evaporative cooling tower, the approach temperature for a design wet bulb temperature of 77°F needs to be less than 7°F. An approach temperature of under 7°F requires an extremely large cooling tower. URS chose a generally accepted, though robust, approach temperature of 9°F in order to maximize power production with a low inlet water temperature while, at the same time, requiring a reasonably sized cooling tower. At the design wet bulb and approach temperatures, the inlet water temperature to the condenser during the PJM peak period is 86.1°F.

The recirculation of the warm moist air from the exhaust of the cooling tower into the air intake reduces the ability of the tower to cool. The potential of air recirculation is reduced with a hybrid tower compared to the base tower. The exit of the exhaust diffuser of the hybrid cooling tower is 18-feet higher than with the mechanical draft evaporative cooling tower.

3.3.4 Water Balance

OCGS' current open-cycle cooling system has virtually no consumptive water use. With the addition of a closed cooling system, the water flow through the intake/discharge system is reduced. However, there is consumptive use of water. As water is evaporated in the cooling tower, the amount of dissolved and suspended solids and minerals in the water become concentrated. If left uncontrolled, these chemicals will inhibit the operation and efficiency of the cooling tower with a buildup of slime and scale.

To control scale and slime build-up, a certain percentage of water is discharged (as "blowdown") from the cooling tower basin into the discharge canal. Makeup water that is pumped to the cooling tower

replenishes the water evaporated and the blowdown water. The ratio of total dissolved solids (TDS) in the recirculating water to the TDS in the makeup water is termed "the cycles of concentration". Cooling towers using makeup water with low dissolved impurities typically operate with a cycle of concentration factor between seven and ten. The industry standard for cooling towers using salt water or brackish water, such as at the OCGS site, is two or less cycles of concentration.

URS sent the detailed water analysis from the 1992 EBASCO study to cooling tower vendors for their comments. Based on their comments and good engineering practice, URS used a maximum cycle of concentration factor (CF) of two. Using the formula $Mass_b = Mass_e / (CF - 1)$, for every pound of water evaporated, an equivalent pound of water is required for blowdown flow.

Two 10,000 gpm pumps would be used to supply the makeup water to the cooling tower. The makeup water would be supplied from the intake canal and sent to a filter skid to remove silt and other foreign substances.

During the summer, when the hybrid cooling tower would be operating in full evaporative cooling mode, the average makeup water supply would be approximately 14,000 gpm. Using a cycle of concentration factor of two means that half the makeup water flow (7000 gpm) is returned to the discharge system as blowdown with the other half evaporated. Thus, the average consumptive use of intake water during the summer is approximately 7000 gpm.

To mitigate the impacts of an inadvertent release of radioactive water, OCGS' procedures mandate that at least one dilution pump or one circulating water pump be available to provide sufficient flow to dilute the radioactive release. Specifically, these procedures are:

- Section 3.1 of Oyster Creek Generating Station Procedure ABN-27 "Inadvertent Overboard Radioactive Liquid Release or Cross-Contamination" states "If a discharge to the intake or discharge canals has occurred or is suspected, then confirm at least one Dilution Pump or Circulating Water Pump is operating."
- Procedure 323 "Main Condenser Circulating Water System" at 5.2.2 states "At all times at least one dilution pump or one circulating water pump must be available to provide dilution flow to mitigate the consequences of an accidental release of contaminated liquid from the RBCCW (Reactor Building Closed Cooling Water System)."
- Section 5.2.2 of Procedure 324 "Thermal Dilution Pumps" states "At all times at least one dilution pump or one circulating water pump should be available to provide dilution flow to mitigate the consequences of an accidental release of contaminated liquid from Service Water System discharge."

In the event that there are no circulating water pumps available, such as during the maintenance of the pump, intake tunnel, or main condenser, at least one of the three dilution pumps must be available to meet these procedural requirements. The available pump will also allow water from the intake canal to be available to supply other emergency needs.

In addition to having operational dilution pumps available, a single dilution pump must remain in operation to:

- prevent the stagnation of water and accumulation of silt in the intake and discharge canals
- provide thermal dilution of warm blowdown water (from the cooling tower circulating water outlet line) at the discharge canal
- provide dilution of concentrated and trace elements in the blowdown water within the discharge canal

There would be no thermal impacts because of the operation of one dilution pump.

One dilution pump (260,000 gpm), with a makeup design requirement of 20,000 gpm, would create a total flow through the intake canal of approximately 280,000 gpm. The flow through the discharge canal would be approximately 270,000 gpm, or about 30 percent of the flow of the current open-cycle system.

3.3.5 Water Treatment

If unchecked, the silt in the makeup water will accumulate, fill basins within the towers, and require the station to shut down sections of the cooling towers for a cleanout. For this reason, the makeup water will be sent to separate inlet filter skids to remove silt and other suspended solids thereby reducing the maintenance requirements.

The filters will also remove a high percentage of the bio-fouling aquatic biota. The removal of bio-fouling organisms will reduce the chemicals required to control their growth in the warm environment of the closed-cooling system. Currently, OCGS uses sodium hypochlorite to control biological growth. Other chemicals, such as acids, dispersants, scale inhibitors, foam suppressants, and de-chlorinators also may be required.

Both cooling towers would have a small (3000 gpm) continuous side-stream filter system. This system would be used to control airborne foreign material (sand, insects, pollen, etc.) that is often captured with the air.

3.3.6 Location

Two potential locations are available for the towers:

- The area adjacent to, and north of, the station (bordered by the intake canal to the north and U.S. Route 9 to the east). The excavated material from the building foundations and from the intake and discharge canals was deposited here during the construction of the station.
- The area east of the station across U.S. Route 9 (Finninger Farm).

The placement of the cooling towers north of the existing station and west of U.S. Route 9 is the preferred location because of shorter pipeline runs and reduced pumping power requirements. This area, however, is congested and would present difficulties in access, construction, and maintenance. Some of the existing equipment would need to be relocated to install the circulating water pipelines.

The placement of the cooling tower on Finninger Farm is an alternate location that was discarded because the pipeline runs are far longer and the pumping requirements are higher. This option is complex because it requires the construction of underground conduits, utilities and access roads beneath U.S. Route 9. Furthermore, since Finninger Farm has sensitive terrestrial and aquatic habitats, the environmental permitting would be difficult.

As shown in Figure 4, the chosen location, west of U.S. Route 9, covers 27.7 acres and is bordered by a security fence, U.S. Route 9, and the intake canal. Currently this area contains grasses, shrubs and several mature trees. There are freshwater wetlands and transition areas that are protected by deed restrictions required by an existing NJDEP permit (see Section 5.3.3). In addition, an aboveground transmission line runs along the boundary between the station and the selected area.

The impervious area, to be occupied by new structures and roadways, would be about 10.5 acres distributed as follows:

- Roadway inside/outside security fence = 2.4 acres
- Cooling tower basins = 3.0 acres
- Pump houses = 0.5 acres
- Impervious area around structures = 2.75 acres
- Filters = 0.2 acres

- Electrical/chemical buildings = 0.15 acres
- Roadway to cooling tower = 0.5 acres
- Permanent parking lot = 1.0 acres

Ground elevations throughout the selected area vary from sea level up to 34 feet above mean sea level (msl). URS selected a final grade (20 feet above msl) where the cut and fill are balanced. URS calculations indicate that the cut and fill volumes would be 145,000 and 125,000 cubic yards, respectively.

The surface soils consist of brown fine-grained sand and brown silty clay. The subsurface soils are fine-grained brown sand with traces of silty clay. Ground water levels throughout the area vary between sea level and approximately 12 feet above msl. Available water quality analyses indicate groundwater pH levels can be as low as 3.5.

3.3.7 Layout

The existing once-through cooling water system would be converted to a closed-cycle system by the addition of a cooling tower and two new circulating water pump houses (Figure 4). The existing circulating water pumps would be decommissioned. Three of the existing sumps for the circulating water pumps would be reconfigured to install three new makeup water pumps.

At OCGS, the proper placement of the towers, with respect to the prevailing wind direction, would be with the longitudinal length of the towers parallel to the prevailing summer wind. URS reviewed the annual wind rose for the OCGS site and aligned the towers in an arrangement that would provide optimum orientation within the site constraints of the area where the towers would be located.

The proposed layout of the cooling tower would avoid direct impacts to the wetlands and transition areas thereby reducing the available land area to 19.9 acres. Since the cooling towers would be constructed and installed within the perimeter of the security fence, the actual area available would be 13.0 acres. As shown in Figure 4, the reduced area would be adequate to accommodate two multi-cell cooling towers arranged in two rows with two pump houses.

The conceptual model is a recirculating closed-cycle hybrid cooling system with two multi-cell mechanical hybrid fiberglass cooling towers arranged in two rows. The towers would be located adjacent to the existing plant, west of U.S. Route 9, and would be 80 feet high operating at two cycles of concentration. There would be two pump houses for the circulating water system and one dilution pump would be operating.

Heated water from the circulating water discharge flume (tunnel) would be diverted to the proposed mechanical draft cooling by means of a 12-foot diameter pre-stressed concrete cylinder pipe (PCCP) to the cooling tower lift pumping station. After passing through the cooling tower and into the circulating water pump house, the cooled water would be pumped back to the condensers via the existing circulating water supply flume (inlet tunnel).

The remainder of this chapter presents a description of the conceptual model and further discusses the impacts to the plant.

4.1 DESCRIPTION OF CIRCULATING WATER SYSTEM

The following modifications and new structures would need to be installed for the conceptual hybrid cooling tower system.

- Interconnections between the plant's existing discharge tunnels and the new circulating water conduits
- Two new 12-foot diameter PCCP conduits to convey circulating water to and from the cooling towers
- Two new pumping stations
- Two new cooling towers
- Two new cooling tower basins
- New cooling tower makeup system
- New cooling tower blowdown system
- Relining existing flumes
- Condenser water box replacement

The remainder of this section describes each of these modifications.

4.1.1 Interconnections Between Existing Cooling Water Supply and Discharge Flumes with the New Circulating Water Conduits

OCGS' existing cooling water supply and discharge flumes cannot be directly connected with the new circulating water conduits due to geometrical differences. The flumes are rectangular in cross-section and the new circulating water pipes would be circular in cross-section. The connection could be made by constructing two transition chambers (intake and outlet transition chambers).

The internal dimension of the chambers would be 17-feet high by 17-feet wide by 20-feet long. The chambers would be constructed using reinforced concrete and foundation on piles to avoid settlement and joint failures.

4.1.2 Two New 12-Foot Diameter PCCP Conduits to Convey Circulating Water To and From the Cooling Towers

Cooling water would be transferred from the cooling water system flumes to and from the cooling towers via two 12-foot diameter PCCP conduits that must be constructed underground. Due to numerous pipe and electrical utility interferences, the initial 500 feet of the pipelines would be installed in a deep trench. The invert of the pipelines would slope upward, raising from elevation 40 feet below msl at the location of the transfer structure to about elevation 6 feet below msl near the existing Torus Water Storage Tank.

The installation of this first 500 feet of 12-foot diameter PCCP segment would require:

- Relocation and support of numerous utilities that interfere with the pipeline routing. Affected utilities include the emergency reactor shutdown pipeline, the water supply to the service and auxiliary heat exchangers, fire protection lines, electric feeders, telephone lines, storm sewers, illumination post and hydrants.
- Extensive sheet-piling to excavate the 20- to 40-foot deep trench required to install the PCCP conduits.
- Driving 100 piles to support the PCCP conduits.
- Extensive and continuous dewatering during construction.

The installation of the subsequent 1,100 feet of 12-foot diameter PCCP segments would require:

- Excavation of a trapezoidal trench to elevation zero (sea level)
- Backfilling the pipelines with flowable fill

The pipeline trenches would also be used to install the 30-inch diameter high-density polyethylene (HDPE) makeup pipeline and some of the electrical conduits.

The installation of the two new 12-foot diameter PCCP conduits would be very difficult to accomplish because of the existing nuclear power plant infrastructure and would require the plant to be shut down during installation of the first 500 feet of PCCP conduits.

4.1.3 Two New Pumping Stations

Two new circulating water pump houses would be required. One of the pump houses would pump the circulating water into the cooling tower. The other would pump the water from the cooling tower basin back to the condensers.

Both new pump houses each would have four circulating water pumps rated at 115,000 gpm each with variable speed motors. Both pumping stations would also need a 72-inch diameter motor-operated butterfly valve to be installed at the discharge of each circulating water pump.

4.1.4 Mechanical Draft Cooling Towers

The mechanical draft cooling tower assembly would consist of two cooling tower units each consisting of 18 back-to-back cooling tower cells installed in two rows. The towers would be constructed of fiberglass and contain polyvinyl chloride fill. The total design flow for the cooling towers would be 460,000 gpm (12,800 gpm per cell).

Thirty-six 36-inch diameter steel pipe risers would distribute the circulating water flow into each of the cooling tower cells. The diameter of the underground manifold would vary between 144 inches (12 feet) and

96 inches (8 feet). A 36-inch diameter valve would be installed at each cooling tower riser, and would be manually operated. A cold weather bypass with six 48-inch diameter spargers would provide freeze protection during the winter.

4.1.5 Cooling Tower Basins

The two rectangular cooling tower basins (120 feet wide, 500 feet long and six feet deep) would be separated by the forebay of the pump house that returns cooling water back to the condensers. The cooling tower basins would be constructed of reinforced concrete and supported by a piling foundation consisting of 600 piles per basin

4.1.6 Cooling Tower Makeup and Blowdown Systems

The current system consists of two water intake structures (a circulating water intake structure and a separate dilution/bypass water intake structure), both of which withdraw water from the intake canal. The dilution/bypass water is used to temper the thermal discharge from the circulating water system (Figure 5). The circulating water intake structure consists of two sections, each having two circulating water pumps and three intake bays. The dilution/bypass intake structure consists of three sections, each having one dilution/bypass pump and two intake bays.

With the new system, makeup water would be pumped from the intake canal by three 50-percent capacity pumps (rated at 10,000 gpm each with the third pump being an emergency backup) into the cooling tower basins. Makeup water would pass through a filter prior to entering the basins. Water quality within each basin would be maintained by the addition of two side filters (one for each basin).

The blowdown water would be returned to the structure that houses the dilution pumps. The blowdown piping system would discharge water into two of the existing dilution pump discharges by means of discharge sparger that would mix the water from the blowdown flow with the dilution pump flow.

4.1.7 Relining of Existing Cooling Water System Flumes

The existing rectangular flumes that interconnect the circulating water pump house with the condenser and, in turn, the condenser with the circulating water system discharge structure are not designed to sustain the operating and transient pressures imposed by the addition of the cooling towers. Presently, the flumes are designed for 47 feet of hydrostatic pressure (2.3 feet water head per pound per square inch). These operating pressures would be increased up to 50 pounds per square inch (115 feet of water). Consequently, the existing flumes would have to be reinforced by adding structural members. The flumes would be reinforced by installing a ¾-inch thick plate steel liner along the walls of the flumes. A steel liner was selected to maintain the available flow area close to the existing cross-sectional area.

URS estimates that a 150-day outage would be required to install the steel lining along the existing flumes and interconnect them to the previously installed circulating water pipes. The installation of the liner would be a complex, time consuming and difficult operation, as indicated by these conditions and steps:

- Some of the rectangular conduits are small; the dimensions of the rectangular cross-sections are variable; and hand fitting would be required.
- Extensive and continuous dewatering would be required.
- Existing concrete surfaces would be repaired, sandblasted and coated with an epoxy base.
- Installation of steel plate support system

- Installation of fans to vent the area. Venting should be outwards, from the turbine room to the manholes and existing openings.
- New temporary ductwork would need to be installed in the turbine building for fresh air.
- Operations would occur in confined spaces.
- Installation of venting system would require removal of 12 condenser water boxes, valves and interconnecting piping.
- Insertion of numerous and heavy steel plates
- Supervised welding and testing of each steel plate
- Injection grouting behind steel plates
- Quality assurance program
- Steel surface preparation
- Application of epoxy coatings

4.1.8 Condenser Water Box Replacement

Each of the station's three condensers is divided into two separate sections, each section having its own inlet and outlet water boxes and associated valves, for a total of six condenser sections. Each condenser section is comprised of 14,560 individual condenser tubes. The six 72-inch diameter pipes that convey intake water to each of the condenser sections are embedded in the reinforced concrete foundation of the turbine building. There are also six 72-inch diameter outlet pipes to convey water from the condenser sections to the buried discharge conduit.

The new 12-foot diameter pipe that would be connected to the existing cooling water supply flume would convey water from the cooling tower basin to the intake of the condenser where the pipe would be bracnched out to distribute flow to the six condenser inlet water boxes. After passing through the condenser tubes, the heated water would enter the outlet water boxes and be piped to the existing discharge flume. The water would then be piped to the other new 12-foot diameter return pipe back to the cooling tower. At the cooling towers, lift pumps would supply water to a distribution header for the two cooling towers.

Based on a hydraulic analysis, URS determined that the pressure of the circulating water at the condenser would exceed the tested pressure of the original water boxes of 25 pounds per square inch gauge (psig). The existing 12 water boxes would need to be replaced with new water boxes with an adequate pressure rating. The URS analysis concluded that the new water boxes would require a design pressure of 50 psig, (and be tested to 75 psig).

Currently, 72-inch butterfly valves, as well as other smaller bypass valves, are attached directly to each of the inlet and outlet water boxes and are integral to the operation of the plant. If, during disassembly or installation of these valves and the water boxes, the valves are damaged or determined not to be in good repair, the lead time to either repair or obtain new valves would greatly extend the overall outage. Therefore, URS determined that new valves should be ordered, supplied and replaced with the new water boxes. URS assumed that the existing tube sheet and titanium tubes are adequate to withstand the added hydraulic pressure of the new design.

Each of the 12 water boxes is approximately 11½ feet high, eight feet wide, and over nine feet deep. URS conducted a study to determine the best way to place the water boxes in the basement. Based on review of arrangement drawings and discussions with plant personnel, URS determined that the wall on the west side of turbine building must be removed to provide access to the basement. The installation

and removal of the water boxes on the east side of the condensers would be troublesome because of restrictive access. Some demolition and removal of stairways would be required, as well as scaffolding and rigging to lift heavy equipment. Replacing the water boxes would be very difficult and could increase the outage time requirement and cost. This operation would need precise planning and execution.

4.2 IMPACTS TO THE PLANT

The installation of the conceptual model would directly affect numerous aspects of plant operation. More specifically, the new design would create:

- Complex operator responsibilities
- Additional maintenance
- Reduced generation
- Increased costs

The remainder of this section examines each of these issues.

4.2.1 Complex Operator Responsibilities

The hybrid cooling towers would create another complex system for the operators of the plant to learn. Although the hybrid cooling tower would be instrumented and automated, there are many issues that would require their close attention. One of the design constraints that led to the decision to choose hybrid cooling towers was the potential of ground fogging, which would compromise the security of the nuclear facility. Operators would need to be diligent to make sure that fog would not form and they must take immediate actions to eliminate it when potential fogging conditions exist.

The hybrid cooling tower would have louvers at the inlet to the dry section of the tower. The purpose of these louvers is to cut off air flow through the dry tower section (see Figure 3) when there is no potential for a visible plume to occur. Closing the louvers optimizes the cooling efficiency of the tower. It is possible to modulate the louvers through the day to obtain optimum cooling of the circulating water (hence steam turbine power output) when ambient temperature and relative humidity are varying. This would require contimual operator attention because of the size of the towers and the interaction between the 36 cells. Changing the position of one set of cell louvers can affect the air psychometric (humidity) conditions of the adjacent cells, thus requiring ongoing adjustment to their louvers.

Operation experience of facilities with hybrid cooling towers has shown that operators will normally, at the beginning of the fall season, open the louvers and run the cooling tower in a combined wet and dry mode. When operating in this mode, the warm air from the dry section mixes with the humid air from the lower evaporator section eliminating the visible plume. At the end of the fogging season, the louvers are closed and the tower is operated as an evaporative cooling tower. By initially setting a design basis to operate in this open-close manner, the initial cost of providing actuators for all 36 cells is eliminated. In addition, the added maintenance that would eventually be required for the actuators is removed. URS assumed that the hybrid tower would be designed and operated in an open-closed mode with the louvers fully opened during the fall, winter, and spring, and fully closed during the summer.

Both of the towers would consist of 18 individual cells. Each of the 36 cells would contain its own forced draft fan with a 250-horsepower motor and attendant speed-reducing gear box. To reduce the operational variations with a large number of cells, single-speed motors would be provided for each cell. If conditions exist such that excessive circulating water cooling is taking place, operators can individually shut down cells in lieu of operating a number of motors at half speed to obtain the desired reduction in cooling.

In contrast to the once-through system, which has one set of circulating water pumps, the conceptual closed-loop system would have two sets of circulating water pump combinations. The first set (circulating water) would take the water from the cooling tower basin and send it through the supply pipe to the three condensers then directing flow back to the cooling tower discharging into a pump basin. A second set of pumps (cooling tower lift pumps) would be required to take the heated water, distribute it to each of the 36 tower cells, and provide sufficient head to lift the water 60 feet to the top of the cooling tower. Because the two pumping systems would be in series, they must operate in unison and balance such that one system would not pump more or less water than the other. The variable frequency drive motors would allow for fine-tuning and flow balance between the circulating water lines so the pump basins do not run dry or overflow.

4.2.2 Additional Maintenance

With the addition of a large piece of sophisticated equipment, additional maintenance would be required to keep the cooling tower operating at optimum form.

Each of the 36 tower cells would have a 250-horsepower motor and gear box to drive the 28-foot diameter forced draft fan. The motors and gear boxes would be on the tower deck in a harsh humid and wet environment. Gear boxes are known to have maintenance problems, thus spares would be required. There also would be the need for frequent maintenance to make sure the motor and gear boxes are lubricated. Routine inspections would required to make sure the fan foils are kept clean and the internal film fill packs are in proper working order. Over time, environmental factors such as salt deposition in the recirculating water would cause the film to deteriorate. One of the tower vendors estimated that the film needs to be replaced approximately every ten years.

The circulating water would be distributed to the towers along a water distribution header. From the distribution header, there would be a supply riser that supplies water to each of the 36 cells. Each riser would have a motor-operated shutoff control valve to isolate the specific cell so maintenance could be completed while the rest of the towers remain on line. Some of the risers also would have a 48-inch bypass line with motor-operated valves that would be used for cold weather start-up protecting the tower from ice damage during starting procedures when there is little heat in the circulating water. Preventive maintenance would be required for the aforementioned systems, valves, actuators and control instrumentation to maintain the cooling towers in proper working condition.

The makeup water that would be supplied from the intake canal would be pumped to a filter skid. There also would be a side-stream filter system to maintain continual cleaning of the water in the basins beneath each of the towers. The purpose of these filters would be to remove silt, biological material, and airborne debris that could affect the overall performance of the towers. The filters would be automatically backwashed to remove the accumulation of silt and debris. The backwash water would be sent to a settling pond that would require periodic clearing of debris. The periodicity for cleaning and disposal of the accumulated material in the settling pond would vary, depending on the season, tidal conditions, and frequency of coastal storms. Thus, the pond would need to be monitored to prevent it from overflowing. The condition of the filter also would need to be observed to keep it from clogging or failing.

The filters would be the first line of defense to protect the cooling towers, fill, and basins from accumulating dirt and other materials. Over time, however, there would be an accumulation of solid material that would affect the performance of the tower. When this eventually happens, a section of the tower would need to be shut down and manually cleaned to remove the silt and other debris from the basin.

Various chemicals would be used to maintain water quality. Although there would be automatic dispensing of the chemicals, operators would need to keep sampling probes calibrated, and make sure the chemical pumps are operating properly, and that chemical holding tanks contain sufficient and proper chemicals.

4.2.3 Reduced Generation

The conversion of an open-cycle cooling system to a closed system using hybrid cooling towers would change the steam turbine performance and impact power generation. URS undertook a study to determine the change in steam turbine performance as measured in low-pressure power production. URS used Thermal Flow's GTMaster program to compare the once-through cooling output at OCGS with the hybrid cooling output. The remainder of this section describes the findings of URS' study.

4.2.3.1 Steam Turbine Generators

The power generated from a steam turbine is derived from high-pressure steam produced in the boiling water reactor and expanded through a series of blades. Stationary blades channel the steam onto rotating blades, which are attached to a common shaft (rotor) connected to the generator for electric power production. The steam turbine at OCGS consists of a high-pressure section and three low-pressure sections. As the steam passes through the blade stages, the pressure and the temperature of the steam decrease and volume increases dramatically. As a result of the volume increase, three double-flow low-pressure turbine elements are needed to pass the flow. When the steam exits the last stage of each low-pressure turbine, it is directed into each turbine's condenser. A vacuum is created when the cooler circulating water passing through the condenser tubes causes the steam to condense.

The amount of power produced is maximized by creating the lowest possible exhaust pressure. The exhaust pressure is primarily set by the inlet circulating water temperature (see Section 3.3.3). With all things being equal, the lower the temperature of the inlet water circulating to the condenser, the lower the exhaust pressure and the more power that is produced.

4.2.3.2 Performance Model

Thermal Flow's GTMaster simulation program was used to model the low-pressure turbine section of OCGS. The reference library for this program includes the exhaust loss curve of the General Electric 38-inch low-pressure steam turbine that is installed at OCGS. The inlet steam pressure and temperature conditions and exhaust steam flow were matched to those of the original General Electric 640.7 MW full load heat balance diagram. The physical dimensions of the condensers were also input into the program to fully model the existing turbine-condenser system.

Ambient dry bulb and wet bulb temperatures for winter (December, January, February), spring (March, April, May), summer (June, July, August) and fall (September, October, November) were obtained from the National Oceanic and Atmospheric Administration database for Atlantic City. Daily maximum, average, and minimum intake canal water temperatures between August 1987 and February 2000 were available from the plant. These data were used to calculate the average winter, spring, summer, and fall water temperatures at the intake.

Six cases (the four seasons and two PJM peak capacity periods) were run to obtain the average seasonal power generation at OCGS with once-through cooling and hybrid tower cooling. The power generating capability of the low-pressure turbine at OCGS with once-through cooling was compared with the power production predicted by the model when the steam turbine operates with a closed-cycle cooling system.

For the model runs of the once-through system, historical pump operation data were provided by the plant. Normally, two dilution pumps and four circulating water pumps ran throughout the year, but during the coldest part of the winter the plant occasionally operated only three of the four circulating water pumps.

For the model runs of the hybrid tower system, URS used the low-pressure turbine flow, pressure, and inlet temperature conditions used in the once-through model runs. The hybrid tower was assumed to be

operated with louvers closed for summer operation, and fully opened for fall, winter and spring (as discussed in Section 4.2.1). During the summer, an allowance was made for flow leakage through the louvers. To provide adequate cooling water flow through the condenser, all eight circulating water pumps were operated for all six cases. One of the dilution pumps was operated continuously (for reasons stated in Section 3.3.4).

Table 2 summarizes the input data and the results. The net plant output for both systems is the net output from the steam turbine minus the sum of the pump and fan loads. A number of smaller loads, such as the cooling tower basin recirculation filter pump, chemical supply pumps, control system, and tower lighting, are not included in our calculations. The calculated average annual net power loss over the four seasons is 32,502 kilowatts, or 32.5 MW.

In each of the six cases, there would be a reduction in net plant power with the hybrid tower system. Despite the fact that the actual power generated from the steam turbine with a once-through cooling system during the PJM summer peak period is approximately 4 MW greater than the power generated with the hybrid cooling tower system, the net plant output would be lower. As noted above, the lower the temperature of the inlet water circulating to the condenser, the lower the exhaust pressure and more power is produced. During the PJM summer peak period, the average temperature of inlet circulating water to the condenser is 83.7°F for the once-through cooling system compared to 86.1°F for the hybrid tower system. The net plant production still would be reduced, however, because of power losses from the cooling tower fans and additional pump loads.

With fossil-fuel fired plants replacing the lost generation at OCGS, URS has assumed that the increase in cooling water use at these plants would be 32.5 million gallons per day. There would also be increases the air emissions at the fossil-fuel plants that replace the lost generation at OCGS. URS estimates that the additional emissions from fossil plants within New Jersey would range between 478 and 3,140 tons per year (tpy) of sulfur dioxide and between 300 and 1,495 tpy of nitrogen oxides (see Section 5.3.1 on air quality).

In summary, there would be a net reduction in power generating capability with the hybrid cooling towers.

4.2.4 Increased Capital and Operating Costs

Significant costs would be involved to retrofit OCGS' existing open-cycle cooling system with a rectilinear mechanical draft wet-dry hybrid cooling tower system. Table 3 summarizes the estimated capital and operating costs of the selected conceptual model for a 10-year period in 2006 dollars. URS applied an amortization period of 10 years with a seven percent discount rate to be consistent with the methodology used by the USEPA to estimate the capital and operating costs of compliance with the Rule (see Appendix A of the Rule at 69FR41679 (footnotes 2 and 3) and USEPA (2004)).

The detailed cost analysis is provided in Appendix B. The cost-cost analysis to determine USEPA costs is provided in Appendix C.

The estimated net present value (NPV) of capital and operating costs of the hybrid cooling tower conceptual model are between $705 million and $801 million. USEPA estimated compliance costs at OCGS to be $11.2 million per year ($4 million for the cooling water intake structure and $7.2 million for the dilution water intake) annualized over a 10-year period, or a NPV cost of $79 million. This amounts to an estimated cost 8.9 to 10.1 times the USEPA cost. The costs are both significantly greater than and wholly disproportionate (at least seven times) to USEPA's estimated compliance costs.

The factors considered in the cost estimates include construction (materials and labor), lost capacity/energy revenue during construction, environmental permitting, added real estate taxes, cost of modifying OCGS' Master Plan, added security and plant operation personnel, added insurance, maintenance, and chemicals, and unforeseen events. Starting costs, which could also be substantial, were not included. Startup testing of the new system could increase outage time and cost. The remainder of this section explains the basis and development of these cost estimates.

4.2.4.1 Construction

Total construction costs include material and labor components. The accuracy of these estimates is within +/- 25 percent.

Material: The estimate for the cost of materials is based on vendor quotations on the higher cost equipment (cooling tower, large valves, large diameter pipe, large pumps, water box components, and electrical transformers), an in-house database of previous vendor quotations, previous applications, and the 2006 RS Means Mechanical Cost Data book. The direct cost estimate is supplemented by allowances for engineering, construction management and contingency fees with a base year of 2006.

In addition to new equipment, URS' estimate includes recognition of required retrofits, relocations, removal, and interconnection to existing systems along with additional foundations and structures. The equipment cost of the cooling tower is based on budget pricing received from vendors. Because this project does not qualify for the New Jersey sales tax exemptions awarded to cogeneration projects and qualified businesses in an economic enterprise zone, the material component of the construction cost is subject to the six percent tax. The base material cost, not including builders' mark-ups, contingencies, and New Jersey sales tax, is estimated to be $102.5 million with an additional $7.1 million for New Jersey state income tax.

Labor: Labor cost estimates are based on the quantities associated with the conceptual design. These quantities form the basis for corresponding component and material costs determined on a unit material and labor cost basis. Much of the labor cost is estimated from Means data for the New Jersey area. The labor estimate from Means includes a general labor productivity factor for the local region.

To account for labor constraints at a nuclear plant where an estimated two man-hours per person per day are needed to comply with daily security entrance/exit requirements and pre-assignment and safety briefings, an additional construction loss-of-productivity factor of 1.25 was applied. The cost of installing the cooling tower is based on man-hour estimates received from a cooling tower vendor. The total labor portion of construction including the loss-of-productivity factor is $176.9 million.

Contingencies: A 15 percent contractor's markup on bulk materials is added to the base materials costs. This allocation is due to the scarcity and long-term delays of materials from the world market. During the past two years, there has been a sharp rise in the cost of construction materials and, because of increases in fuel prices, an increase in delivery costs. The world market, especially in the Far East, and domestic requirements due to recent natural disasters has put a strain upon the availability of various commodities, as well as the ability to schedule delivery from overseas suppliers. The contractors' markup at 15 percent amounts to $15.4 million.

The degree of confidence on the availability of labor and material also affects the potential pricing of a project. Thus, URS added a 25 percent contingency to reflect the possibility of delays in the construction schedule. Labor or material shortages also delay the project and increase costs. The 25 percent confidence factor on labor and material accounts for $61 million. Including markups, sales tax, and contingencies the total material cost is estimated to be $150.5 million and the total labor cost is estimated to be 212.2 million.

Other factors that could affect the schedule, and thus cost, are weather uncertainties, delays in obtaining proper environmental and construction permits, and construction uncertainties. The construction uncertainties include setting sheet piles and dewatering the pipe trench. The trench is trapezoidal with a base width of 40 feet (90 feet at the surface), 20 feet deep, and 1000 foot long adjacent to the intake canal. URS included only 150 days in the construction schedule to overcome potential interferences and obstructions when running the initial 500 feet of piping trench across critical emergency components required for safe operation and shutdowns of the plant.

URS did not include these additional items in the total capital costs:

- Allowance for funds used during construction (AFUDC or the estimated debt and equity costs of capital funds necessary to finance construction)
- Allowance for startup
- Allowance for spare parts
- Working capital or inventory capital
- Allowance for client engineering and management
- Assessment of the costs of replacement power during construction
- Royalties (due to patented procedures used by construction contractors)
- Exelon's internal costs
- Outside legal counsel
- Construction-period security personnel.

Lost Capacity/Energy Revenue: The loss of generating capability, which was discussed in Section 4.2.3, affects the income of the unit. Energy calculations (in megawatt-hours [MWH]) include the OCGS capacity factor goal of 92 percent. URS was provided the PJM monthly energy and capacity forward pricing for OCGS from January 2006 through December 2025. The monthly energy values ($/MWH) were averaged to obtain seasonal energy averages. The capacity price value is constant over the year. Both the energy and capacity prices were levelized to determine the net present value of the pricing over a ten-year period starting in January 2008 using a seven percent discount rate.

The PJM summer capacity reduction in output of 20.8 MW is used to determine the reductions in capacity payments. The load reductions for the four seasons (winter 32.6 MW, spring 40.3 MW, summer 13.7 MW, fall 43.4 MW) are used to calculate the loss in energy revenue at the levelized seasonal energy price. The loss is considered to be a continuous loss over the ten-year period. The lost capacity revenue over the ten-year period is $7.1 million, while the lost energy revenue over the same time frame is $108.4 million

Lost Capacity/Energy Revenue During Construction: During the construction sequencing, the three major activities that require the unit to be off line are to:

- Tie-in the new circulating water lines with the existing condenser flumes while severing the existing circulation water lines;
- Change main condenser water boxes and isolation valves; and
- Relocate plant safety and emergency lines that cross the path of the piping trench.

For costing, these three activities are assumed to coincide with the fall 2010 refueling outage. Given the anticipated difficulties in obtaining the required permits (see Section 5.0), this as an extremely aggressive schedule.

A minimum estimate of the time required to complete these tasks is 150 days. To meet this schedule, extra manpower effort is required, as well as the ability to work on these activities in parallel as much as possible. There are, however, some activities that preclude parallel work, such as strengthening the existing flumes under the condensers, which requires access to the water boxes to provide ventilating air.

A time goal for refueling at OCGS is 21 days or less. URS assumed that the initial portion of the construction activity, which requires the unit to be out of service, is accomplished during the 21-day normal refueling outage. In determining the lost revenue component, the time allowed for the refueling outage is deducted from the total estimated time. Thus, 129 days of generation are lost.

The lost revenue is, therefore, based on the capacity and energy pricing in effect Fall 2008. This cost is considered a one-time loss. If the 2008 fueling cycle is missed, additional costs will be incurred. The capacity portion of lost revenue is $4.3 million. The energy portion, applying Fall 2008 (70 days) and Winter 2009 (59 days) energy payments, is $80.4 million.

4.2.4.2 Environmental Permits and Public Relations

A number of Federal, state and local permits and approvals are required to commence and complete this project. The cost for these permits includes significant environmental and engineering analysis, reporting, submittals with appropriate fees, and preparation for public hearings. An estimate for the cost of these activities is based on URS experience. The cost, $1.5 million, is considered to be an initial one-time occurrence.

4.2.4.3 Real Estate Taxes

With the addition of a capital investment at the power plant, URS anticipates that real estate taxes paid to Lacey Township will increase. We understanding that the township is free to impose a real estate tax on the full amount attributed to the costs required to implement the change. The full cost is based on the capital estimate, which includes material and labor, but not state sales tax or the various added contingency costs.

URS determined the taxable portion, for real estate purposes, is approximately $300 million. URS calculated the annual tax increase based on the 2008 equalization ratio (32.4 percent) and estimated tax rates from 2008 onward. The additional taxes are considered ongoing added costs. The amount is calculated in 2008 dollars and is not escalated. The anticipated 2008 tax rate is estimated at 3.6 percent ($3.5 million) and increases at an annual rate of seven percent. Over the ten-year evaluation period the total tax burden in 2008 dollars is $48.0 million.

4.2.4.4 Revision of Current Master Plan

OCGS is in the process of developing and permitting a Master Plan for use of the site. A significant amount of effort has gone into the Master Plan to site new buildings and parking areas. Should the installation of the cooling towers go forward, then planners would need to restart the process, including finding other locations for proposed parking areas and buildings. Finninger Farm is a potential alternate site for the Master Plan. URS estimates the sum of the expended costs and added costs for redevelopment will be $500,000. This cost is considered to be a one-time charge to the project.

4.2.4.5 Added Security Personnel

Approximately 13 acres of additional land area would be required for the cooling towers and ancillary equipment. The perimeter of the security fence must be expanded to enclose the new equipment within the addition area. This expansion is necessary for plant security, not to safeguard the new equipment.

Security personnel at OCGS reviewed the proposed layout of the towers and recommended the addition of three new security towers and an additional 4000 feet of fence. The addition of the three new security towers and expanded security perimeter would require additional security personnel. We assumed that eight additional security personnel (two people per tower with an additional two people for off-shift purposes) would be required. The added cost for these people would be an ongoing expense. The current full cost of these individuals is $125,000 per person. Their cost is escalated at 3.5 percent with the net present value determined at the seven percent discount rate for ten years with a total cost of $8.7 million.

4.2.4.6 Added Plant Operational Personnel

The current OCGS operations staff was consulted and they determined that the proposed cooling tower system would require six additional operators. The added cost for the six operators is considered to be an ongoing expense. The current full cost of these people is $150,000 per person. Their cost is escalated at 3.5 percent with the net present value determined at the seven percent discount rate for ten years with a total cost of $7.8 million.

4.2.4.7 Added Insurance

The additional capital equipment at the facility would increase the insurable value. Exelon was consulted regarding the facility's insurance and they estimated that the OCGS insurance premium would increase by $18,000 the first year. Insurance premiums would continue as an ongoing expense. The increased premium is escalated at 3.5 percent with the net present value determined at the seven percent discount rate for ten years. The total cost to OCGS is $160,000.

4.2.4.8 Maintenance and Chemicals

This would be an added cost associated with dispersing chemicals and maintenance. For example, over time, the seals of the large butterfly control valves would require refurbishing from the wear of modulating action. The oil in the cooling tower fan gear boxes would also require periodic changes. Though relatively small and minor in cost individually, these items add up to a significant first year cost of $36,000, or, when escalated at 3.5 percent with the net present value determined at the seven percent discount rate for ten years, the total cost is $300,000. As discussed in Section4.2.2, it is anticipated that the cooling tower film would require replacement after ten years of operation in the salt water environment. The cost to replace the internal film is estimated to be 20 percent of the installed cost of the towers. The cost to OCGS for escrowing the funds to replace the film is $10.6 million.

4.2.4.9 Risk Factor

A range of unforeseen events that could occur, but are outside the ability of the designer to anticipate and account for, is incorporated as a risk factor. These events affect the ability to complete the project within budget and on schedule.

Some examples of these types of events are:

- Dramatic commodity price increases due to catastrophic global events.
- Regulatory oversight changing or requiring new procedures that result in a major redesign.
- Finding a listed rare, threatened, or endangered species on the proposed site.
- Impervious surface requirements (see Section 5.3.2).

The uncertainties and risks associated with regulatory oversight are substantial and are explained in detail in the next chapter.

The design basis for the conceptual model includes the minimization of environmental impacts. Adverse environmental impacts were avoided where possible. Unavoidable impacts are minimized by incorporating the best technologies available into the design. Furthermore, during construction, Exelon would implement best management practices.

URS reviewed Federal, state, local, and regional regulatory requirements to identify potential issues that may preclude regulatory approval. The remainder of this chapter presents the findings of this review.

5.1 TOWNSHIP ORDINANCES AN D STANDARDS

OCGS is required to comply with Lacey Township regulations, in the form of ordinances and standards. The station would need two local variances for this project: one for nonconforming land use and one for the expanded fence. These variances would be difficult to obtain because of the nuisance issues associated with the cooling towers (noise, visual impacts, icing, fog, salt deposition, etc.). This would be a public process and while there are procedural requirements for decision-making, the standards for the exercise of a discretionary denial are often not subject to a successful review and reversal. URS has experienced this with other power plants.

5.1.1 Land Use

The site is in M-6 Industrial Zoning in Lacey Township, Ocean County, New Jersey. The facility is bounded by:

- North: Business Park Zone (M-1)
- West: Industrial Zone (M-6)
- East: Marine Commercial (C-100) and Limited Industrial (M-2)
- South: Ocean Township – General Industrial (I-1)

Residential Zone R-1 in Lacey Township is approximately 1700 feet to the northeast and Waterfront Development (WD) in Ocean Township is approximately 3000 feet to the southeast. The WD zoning in Ocean Township allows for residential development.

5.1.1.1 Zoning Ordinance

Prohibited Uses in M-1, M-2 and M-6 Zones - Part B (28) (§335-67) include *"public utility activity constituting the manufacture of electricity is prohibited"*. The current facility is considered a nonconforming use.

Article V Nonconforming Uses and Structures, §335-38 Continuance, states that an existing nonconforming use may be continued provided that:

- No nonconforming structure shall be enlarged, extended or increased unless by such action it complies with this chapter,
- No nonconforming use shall be expanded,
- No nonconforming lot shall be further reduced in size.

Since the facility is a nonconforming use, it is likely that the township would require a variance to construct the cooling towers.

5.1.1.2 Performance Standards for M-2 and M-6 Zones

Performance Standards for M-2 and M-6 Zones (§335-68) are:

- Control of dust and dirt, fly ash, fumes, vapors and gases: No emission shall be made which can cause any damage to human health, to animals or vegetation or other forms of property or which can cause any excessive soiling of persons or property at any point beyond the lot line. The township will take a close look at tower emissions.
- Control of Noise: Refer to 5.1.2 Noise
- Control of glare or heat: Any operation that produces intense glare or heat will be performed in a building or behind an enclosure so that it can't be seen beyond the lot lines. A variance may be needed if security lighting is required. Typical control of construction lighting and processes (e.g. welding) will be required during construction.
- Control of vibration: Vibrations beyond the property line cannot be discernible by humans without instrumentation.

5.1.1.3 Fencing

Height limit for rear and side yard fencing is six feet and four feet in front yards (§335-22). According to the township zoning department, a variance would be needed for higher security fences.

5.1.2 Noise

5.1.2.1 Noise Ordinance

The Lacey Township noise ordinance (Chapter 242) is intended to protect the public from excessive sound and vibration. While specific sound levels are not referenced in the noise ordinance, complaints about noise are investigated by a township Noise Control Officer. Noise complaints would be possible during construction and operation of the cooling towers.

The prohibited activities that could cause a noise disturbance across a residential property boundary or within a noise sensitive zone include loading, unloading, opening and closing, crates, containers, building materials, etc. between the hours of 10:00 pm and 6:00 am, and construction-related work between 10:00 pm and 7:00 am the following weekday and 10:00 pm and 9:00 am the following weekend day. The township told URS that OCGS would likely be allowed to construct on a 24-hour per day basis. However, the township is concerned about nighttime complaints and could place restrictions on nighttime construction activities.

5.1.2.2 Noise Performance Standards

Lacey Township and the NJDEP have noise performance standards [Lacey Township (Chapter 335 § 335-68) and NJDEP (Chapter 29 - Noise Control 7:29-1.2)]. Since OCGS operates 24 hours per day, the nighttime noise limits would have to be met.

The NJDEP noise regulations establish limits for continuous airborne sound noise. The continuous airborne sound noise limits, for industrial facilities, are 50 decibels (dBA) between the hours of 10:00 pm to 7:00 am or an octave band sound pressure decibel level that exceeds specific octave band frequencies. Lacey Township performance standards are similar to the state standards with some sound limits being slightly higher and some slightly lower at various octave bands.

The octave band criteria for noise are more difficult to achieve. URS' experience with evaluating noise at proposed power plants is that when octave band criteria are applied, a sound variance or sound easement for specific band widths is required.

The noise study conducted for the 1992 EBASCO report compared the expected noise levels from the operation of two alternate cooling tower systems (mechanical draft and natural draft towers) at the nearest residential properties to the state standards, Lacey Township standards, and existing ambient noise levels.

At the time of the EBASCO report, the nearest residential property in Lacey Township was approximately 2250 feet from the proposed cooling towers and the nearest residential property in Ocean Township was approximately 3500 feet from the proposed cooling towers. At present, the nearest residential property from the proposed cooling towers is approximately 1800 feet in Lacey Township. The distance to the nearest residential property in Ocean Township is still 3500 feet at present.

The results of EBASCO's noise study indicated that the loudest alternative was mechanical draft towers with fans operating at full speed. This scenario resulted with sound levels 51 dBA at the residential properties 2250 feet away in Lacey Township and 46 dBA at the residences 3500 feet away in Ocean Township. The 51 dBA sound level exceeded the state limit by 1 dB.

Since the nearest residence from the currently proposed hybrid towers is at a distance of approximately 1800 feet, it is likely that the state limit would be exceeded without the installation of cooling tower silencing packages. Noise studies and modeling would be necessary to determine what type of silencing packages would be needed to meet both state and local standards. A budget estimate of 12.5 percent of the cooling tower cost was added to cover the cost of the silencing packages. However, even with silencing, the hybrid towers might not meet the noise criteria. Sound barriers are not viable at OCGS because they would block the line-of-sight necessary for security.

5.1.3 Height

There are no height restrictions in Lacey Township M-6 zoning.

5.1.4 Land Development (Chapter 215)

The Township Planning Board or the Board of Adjustment, in conjunction with the Township Environmental Commission, could require an Environmental Impact Statement (EIS) (§215-1). This requirement would be satisfied by the Compliance Statement required under the State of New Jersey's Coastal Area Facility Review Act (CAFRA).

5.1.5 Ocean Township

It appears that the closest residential zoning (WD Waterfront Development) is adjacent to the southern property boundary across from U.S. Route 9 and approximately 3000 feet from the proposed location for the cooling towers. The closest building in the WD zoned area is approximately 3500 feet from the cooling towers.

During the Lacey Township public approval process, property owners within a 200-foot radius of the property line are required to be notified about the project. This includes properties in Ocean Township. It is during this process that Ocean Township would probably get involved by attending public meetings and hearings.

Although Ocean Township would not need to approve the cooling tower project, residents would have the opportunity to express similar concerns over the nuisance issues associated with the towers as will Lacey Township residents. It is possible that they might have an influence on Lacey Township.

5.2 COUNTY AND REGIONAL APPROVALS

5.2.1 Ocean County Soil Conservation District

A New Jersey Pollutant Discharge Elimination System (NJPDES) permit for stormwater discharges from construction activities would be necessary. Since there is no coal pile runoff, a Construction General Permit would be issued by the Ocean County Soil Conservation District rather than NJDEP.

A Soil Erosion and Sediment Control Plan would need to be submitted to the Ocean County Soil Conservation District for certification. A Request for Authorization for issuance of the Construction Activity Stormwater General Permit would be submitted after certification of the plan.

5.2.2 Ocean County Planning Board

The new site plan for OCGS would need to be submitted to the Ocean County Planning Board for their review.

5.2.3 Pinelands Commission

According to the Pinelands Commission Regulatory Programs, in a letter dated January 6, 2006, OCGS is outside the Pinelands Area and is, therefore, not subject to Pinelands Commission regulations or review, or subject to Lacey Township Pinelands Area Procedures (Article XVII).

5.3 STATE REGULATIONS

OCGS would require permits from NJDEP's Air Quality Permitting Program and Land Use Regulation Program (LURP). In addition, the New Jersey Department of Community Affairs (DCA) would need to review and approve the project. This section provides a description of the numerous state permits and approvals needed for this project.

5.3.1 Air Quality

Air quality permits would be required to construct and operate the proposed hybrid tower system. The type of permits required would depend on potential-to-emit (PTE) and the existing facility status.

5.3.1.1 Preconstruction Permits

"Minor" projects require a State minor source permit while "major" projects require a Prevention of Significant Deterioration (PSD) permit. PSD review (40 CFR 52.21) is a Federally-mandated program that applies to new major sources of regulated pollutants and major modifications to existing sources. PSD review is a pollutant-specific review. It applies only to those pollutants for which a project is considered major and the project area is designated as attainment or unclassified. The NJDEP has delegated authority from USEPA to administer the Federal Prevention of Significant Deterioration (PSD) preconstruction review regulations.

OCGS is an existing minor source under NJDEP and USEPA air permitting regulations. As such, OCGS would require a state level minor source preconstruction permit and, if the PTE of a regulated pollutant exceeds 250 tpy, OCGS would also be subject to a PSD preconstruction review as a new major source.

The primary pollutant of concern for the OCGS hybrid cooling tower project would be particulate matter (PM). Total particulate emissions are calculated as follows:

QPM = W*60 * 8.34 * SG * DR/100 * S/1,000,000 * 4.38

Where,

QPM = total particulate emission rate in tpy

W = water circulation rate (460,000 gpm)

SG = specific gravity multiplier for circulating water at two cycles of concentration (1.036)

DR = drift rate (0.0005 percent)

S = estimated maximum total suspended solids (TSS) and total dissolved solids (TDS) in the circulating water in parts per million (ppm)

And,

8.34 is the density of water in pounds per gallon

4.38 is the conversion factor from pounds per hour to tpy

60 is the conversion from minutes to hours

100 converts percent to a decimal fraction

1,000,000 converts ppm to a decimal fraction

Based on the conceptual model design specifications, water quality data, and expected maximum cycles of concentration, the total particulate emission rate (or Q_{PM}) is estimated to be 261 tpy. This exceeds the PSD applicability threshold. Thus, the project as proposed, would require a PSD preconstruction permit.

Regardless of the PSD applicability, a state level minor source preconstruction permit would be required. The most significant air permitting requirements of PSD are:

Requirement to install Best Available Control Technology (PSD) or State-of-the-Art (State permit)

Requirement to demonstrate compliance with National and State Ambient Air Quality Standards

Requirement to demonstrate compliance with PSD increments

Requirement to assess impacts at Class I Areas (PSD only)

Requirement to assess other impacts such as fogging and icing, plume shadowing, and salt deposition

For the proposed project, permitting differences between PSD and a State minor source permit are minimal. The PSD Best Available Control Technology or State-of-the-Art state permit reviews are identical. Specific differences in the other requirements are discussed below.

5.3.1.2 Ambient Air Quality Standards and PSD Increments

USEPA established National Ambient Air Quality Standards (NAAQS) to protect public health (primary standards) and public welfare (secondary standards). Similarly, the State of New Jersey has established New Jersey Ambient Air Quality Standards (NJAAQS). New sources or modifications subject to the PSD or state preconstruction permitting requirements must demonstrate compliance with both the NAAQS and the NJAAQS.

Pollutants for which ambient air quality standards exist are referred to as criteria pollutants. For the OCGS hybrid cooling tower project, the pollutant of concern would be particulate matter with an aerodynamic diameter less than 10 microns (PM10). The PM10 NAAQS was promulgated July 1, 1987 and, on July 19, 1997, USEPA promulgated a fine particulate (PM2.5) NAAQS for particles less than 2.5 microns in diameter.

In addition to the NAAQS and NJAAQS, the PSD regulations limit the amount that air quality can be degraded above baseline levels. These allowable increases, or PSD increments, have been established for SO2, NOx, and PM10. All new major sources and minor sources constructed after the area and pollutant specific baseline date use up or consume available PSD increment. Therefore, regardless of whether the Project is subject to the PSD or state preconstruction permitting requirements, a PSD increment consumption analysis would be required.

The PSD increments vary based on the area PSD classification. The project area and surrounding areas are designated as a PSD Class II Area. The nearest Class I Area is the Brigantine National Wildlife Refuge, which is approximately 25 miles to the south of OCGS. The PSD increments for Class I areas are significantly lower than Class II Areas.

A screening analysis of the impact of PM10 emissions on air quality in the area using USEPA's SCREEN3 model (USEPA, 1995) was performed.[2] Results of the screening analysis indicate that PSD ambient air quality PM10 increments, NAAQS, and NJAAQS would not be achieved. An air quality dispersion modeling analysis would be required to demonstrate compliance with the NAAQS, NJAAQS, and PSD increments. Despite the fact that the selected conceptual model incorporates the most efficient state-of-the-art drift eliminator technology currently available, the PSD ambient air quality particulate matter increments and National Ambient Air Quality Standards might not be achieved. This position is based on URS experience with the type of analysis performed for other energy projects, and projections based on the conceptual model design, location, and estimated emissions.

The ability to demonstrate compliance with these requirements and, therefore, to obtain the required preconstruction permits, would be a significant source of uncertainty and presents a significant potential for extraordinary delays. Should the ambient air quality dispersion modeling analyses predict impacts that exceed required levels, the only option to further reduce the impacts would be to reduce the particulate emission rate. Since the proposed design would use the most efficient drift eliminator technology currently available, the only way to further reduce particulate emissions would be to reduce the TDS and TSS concentration in the cooling tower circulating water. This could be accomplished by reducing the cycles of concentration or by pretreating the sea water. More pointedly, further reduction would require Exelon to construct a desalinization plant.

Desalinization represents an extremely costly undertaking and has not been reviewed as part of this analysis. Reducing the cycles of concentration further negates the purpose of the hybrid towers to reduce water flow. Therefore, URS believes that particulates emissions alone are potentially a fatal flaw.

5.3.1.3 Class I Area Requirements

The PSD regulations require projects to assess the air quality related impacts in nearby Class I areas. The nearest PSD Class I Area is the Brigantine National Wildlife Refuge, which is approximately 25 miles (40 kilometers) south of OCGS. Projects within 100 to 200 kilometers of a PSD Class I area must assess these three impacts at the Class I Area:

- PSD increment consumption
- Visibility impacts (regional haze)
- Deposition

PSD requirements for Class I Areas are more stringent than for Class II Areas. A projection of future air emissions would also need to be reviewed and approved by the National Park Service.

[2] The analysis, based on the conceptual model in a draft version of this report, was performed by others in preparation to responding to the Request for Additional Information from the NRC (letter dated December 8, 2005).

5.3.1.4 Fogging

OCGS has recently implemented new security measures. Any occurrence of onsite fogging or a visible elevated vapor plume would significantly limit the effectiveness of these systems. For this reason, as discussed in detail in Section 3.2, URS proposed a hybrid system that effectively eliminates a visible plume and ground fog. The use of this tower technology would eliminate offsite fogging as an issue in the permitting process.

5.3.1.5 Salt Deposition

The high salt content of the makeup water would yield relatively high salt deposition near the cooling towers. Excessive salt deposition could affect the operation of electrical components including switchyard transformers and capacitors.

Salt buildup could cause arcing, corona discharge and reduced efficiency of many components. Salt deposition could also lead to corrosive effects on metal systems, residential home siding, landscaping, boats and automobiles (see Section 5.1 on the effect of nuisance impacts on local variance approvals). Increased rates of salt deposition could also impact local vegetation and aquatic life due to the settling of salt in freshwater wetlands and upland vegetative areas (see Section 5.5 on potential impacts to the nearby Edwin B. Forsythe National Wildlife Refuge). Therefore, URS believes that salt deposition is potentially a fatal flaw and could increase the cost estimate.

5.3.1.6 Other Air Quality Impacts

The replacement of the OCGS once-through cooling system with the hybrid tower system would result in a net average generation loss of 32.5 MW (see Section 4.2.3). This generation would be replaced by fossil-fuel fired generating plants resulting in an increase in fossil-fuel utilization and an increase in emissions at those plants.

Based on an average fossil-fuel plant efficiency of 10.5 MMBtu/MW-hr (EPA AP-42 Appendix A) and an average annual capacity factor of 92 percent for OCGS, 2,750,202 MMBtu of fuel would be required. This equates to 105,777 tons per year of coal; 18,334,680 gallons per year of No. 6 fuel oil; or 2,750,202,000 standard cubic feet per year of natural gas.

The emissions produced as a result of this increased fossil-fuel usage would depend on a variety of factors including fuel type, plant location, and plant efficiency. Emissions were estimated based on emission limitations in New Jersey regulations and past actual emissions for electric generating facilities as reported to the USEPA. Based on emission limitations in New Jersey regulations (N.J.A.C. 7:27-9 Sulfur in Fuels and 7:27-19 Control and Prohibition of Air Pollution by Oxides of Nitrogen) potential increases in sulfur dioxide range from 478 to 3140 tpy and, for nitrogen oxides, range from 300 to 1495 tpy. Based on historical average emission rates as reported to the USEPA by all electric generating facilities in New Jersey, increases in air emissions would be 218,308 tpy of carbon dioxide, 501 tpy of sulfur dioxide, 356 tpy of nitrogen oxides, 1134 tpy of carbon monoxide, and 807 tpy of PM10.

5.3.2 Coastal Zone Management Program

The construction of a cooling tower at OCGS falls under the jurisdiction of New Jersey's Coastal Management Program within LURP. This construction would require a CAFRA permit from LURP and

[3] Note: LURP has stated that the impervious cover limit of Finninger Farm would revert to 30 percent if a CAFRA designation is not approved by March 2007, however, we believe this is a misstatement.

may require a Waterfront Development permit. In addition, before approving a coastal permit, NJDEP must find that the project complies with New Jersey's Coastal Zone Management (CZM) rules. And, since OCGS requires a Federal license (U.S. Nuclear Regulatory Commission license), LURP must also conduct a Federal Consistency review to determine if the project is consistent with the CZM rules (Federal Consistency Determination).

5.3.2.1 CAFRA Permit

OCGS is within the portion of New Jersey's coastal zone regulated under CAFRA (the CAFRA area). Construction of the cooling tower and related structures would require a CAFRA permit and must comply with CZM rules.

CZM rules establish impervious surface and vegetation cover limits at sites within the CAFRA area. These limits are based on a site's location within specific boundaries defined in the CZM rules. The OCGS cooling tower site is located within the expired boundaries of a Town Center (expired February 2005). The Town Center designation for Lacey Township was not re-established for an interim period of March 15, 2006 to March 15, 2007 (New Jersey Register, February 6, 2006). The township is presently seeking clarification by the state if its application for re-establishment as a Town Center, including the Finninger Farm property, can be approved by March 15, 2006.

At present, the CAFRA impervious cover limit on the site is the existing lot coverage. The existing impervious cover at the site is approximately 60 acres, or about 45 percent. If the expired Town Center designation is not re-established for the interim period, there would be no available space for additional impervious cover and the cooling towers cannot be built on the site. Both the cooling tower site and the Finninger Farm property will revert to a CAFRA Coastal Fringe Planning Area designation. The impervious cover limit on the cooling tower site would remain the existing lot coverage and the CAFRA impervious cover limit on Finninger Farm would be between 3 percent and 5 percent with associated vegetation preservation and planting requirements.3

If the Town Center designation is re-established by March 15, 2006, the CAFRA impervious cover limit at the site and on Finninger Farm would be 70 percent during the interim period. At a meeting with LURP, on December 13, 2005, NJDEP said that there is no guidance as to what LURP will do if reviews of CAFRA permit applications for future development are not completed before March 2007 and allowable impervious cover limits are reduced. If a CAFRA permit increasing impervious cover to 70 percent is issued during the interim period for activities other than the cooling towers, it might be possible to request a permit modification to change the activities and impervious surface geometry for cooling towers. Alternatively, a new CAFRA permit might be needed. It is not known if a new permit would allow increased impervious cover beyond the existing cover.

The CAFRA impervious cover limit is a fatal flaw if the Town Center designation is not re-established by March 15, 2006. If the Town Center designation is re-established by March 15, 2006, URS believes the impervious cover limit remains a potential fatal flaw and could increase the cost estimate.

5.3.2.2 Waterfront Development Permit

Within the CAFRA area, tidal waters and lands up to and including the mean high waterline are also regulated under the Waterfront Development Law. Any disturbances of the tidally-influenced intake and discharge channels may be exempt because these waterways are artificially constructed. At this time, URS does not expect that this waterway would be disturbed. However, this could change. A determination of the applicability of the rules governing Waterfront Development permits would need to be made for related structures.

5.3.2.3 CZM Rules

Exelon would need to certify that construction related to a cooling tower and related structures, and their operation, are consistent with New Jersey's CZM rules. While the rules themselves do not specifically refer to cooling towers, their construction and operation would fall under rules related to actions and uses affecting the coastal zone. Based on current conceptual plans for the construction and operation of the proposed project, the CZM rules pertaining to these specific topics must be addressed in the CZM Consistency Statement, which must be certified by Exelon and submitted to NJDEP:

- Filled water's edge
- Wetlands
- Wetlands buffers
- Historic and archaeological resources
- Endangered or threatened wildlife or plant species habitats
- Critical wildlife habitats
- Pinelands National Reserve and Pinelands Protection Area
- Impervious Cover Limits and Vegetative Cover Percentages in the CAFRA Area
- Energy facility use rule
- Water quality
- Surface water use
- Groundwater use
- Stormwater management
- Vegetation
- Air quality
- Scenic resources and design
- Traffic

URS believes endangered or threatened wildlife or plant species habitats, and impervious cover limits in the CAFRA area, are issues that are potentially fatal flaws and can increase the cost estimate.

5.3.2.4 Coastal Wetlands

Coastal (or Tidal) Wetlands permits are required for all activities in coastal wetlands delineated and mapped by NJDEP pursuant to the Wetlands Act of 1970. This Act defines coastal wetlands, in part, as a bank subject to tidal action upon which certain plant species are capable of growing (N.J.S.A. 13:9A-2). N.J.A.C. 7:7E-3.28 establishes a buffer of up to 300 feet adjacent to coastal wetlands.

An examination of Tidelands Sheets 357-2124 (Middle Branch West) and 357-2130 (Middle Branch) identify the margins of the intake canal and the Forked River as upland/wetland boundaries. The bank of the intake canal at the project site consists of riprap and concrete and is not a coastal wetland. However, a formal determination by the NJDEP that the canal margins are not coastal wetlands and that a buffer does not apply should be made.

5.3.3 Freshwater Wetlands, Transition Areas, State Open Waters, and Deed Restrictions

Birdsall Engineering, Inc. conducted a wetland delineation on the site, in accordance with the Freshwater Protection Act Rules (N.J.A.C. 7:7A), in late 2003 or early 2004. Although NJDEP issued a CAFRA permit and a Transition Area Waiver to AmerGen (December 1, 2004) based on plans depicting this delineation, NJDEP is currently questioning the validity of the delineated upland/wetland boundaries and transition areas (wetland buffers) because a Letter of Interpretation (LOI) from NJDEP was never issued.

As a condition of the CAFRA permit, AmerGen was required to file deed restrictions for wetlands and transition areas. In October 2005, AmerGen recorded conservation restrictions approved by NJDEP with the Ocean County Clerk. Regulated activities are not permitted in these areas unless there is a compelling public need greater than the need to protect the areas and the activity has no practicable alternative with less adverse environmental impacts.

Any unavoidable, permanent and temporary, disturbances of wetlands and transition areas on the site would require a Freshwater Wetlands Permit and Transition Area Waiver issued through LURP. Since the original wetland delineation did not receive, an LOI from NJDEP, a new wetland delineation and transition area determination would need to be undertaken to acquire an LOI prior to applying for a Freshwater Wetlands Permit and Transition Area Waiver.

Estuaries and streams, whether natural or artificial, are waters of the State and all waters of the State are State open waters (N.J.A.C. 7:7A-1.4). Regulated activities in State open waters are under the jurisdiction of the Freshwater Wetlands Protection Act, except for non-delegable State open waters, which are subject to the Waterfront Development Law (N.J.A.C. 7:7A-2.2). The intake canal is a non-delegable waterway (see Section 5.3.1). See Section 5.2.2 for a discussion of the applicability of the Waterfront Development Law.

5.3.4 Noise

See Section 5.1.2 (Noise).

5.3.5 Uniform Construction Code

All construction of structures at electrical generating stations in the state must submit plans to the DCA for review and release. The DCA has the responsibility to enforce the New Jersey Uniform Construction Code (UCC). The UCC includes subcodes for building construction, electrical construction, fire protection, plumbing, fuel gas installations, mechanical installations, accessible construction, and the rehabilitation of existing buildings. Once a DCA release is issued, Lacey Township can issue appropriate permits and conduct inspections prior to construction.

5.4 FEDERAL REGULATIONS

OCGS would be required to satisfy the requirements of Federal regulations promulgated by the United States Army Corps of Engineers (USACE) and USEPA. This section discusses the USACE permits that might be needed and the applicable USEPA Clean Water Act Section 316(b) Phase II requirements OCGS must achieve with the installation of cooling towers.

5.4.1 U.S. Army Corps of Engineers

Under Section 10 of the Rivers and Harbors Act of 1899, USACE regulates activities that affect navigable waters of the US. These include activities outside the limits of navigable waters that affect them. The

lower two miles of Forked River are considered navigable waters by USACE. It is not clear if the intake canal is considered a navigable waterway. A jurisdictional determination would need to be made by USACE whether proposed activities affect navigable waters and require a Section 10 permit.

Under Section 404 of the Clean Water Act, USACE also regulates the discharge of dredged or fill material into waters of the US. These include wetlands. While the State of New Jersey has assumed the Federal Section 404 program, USACE still retains jurisdiction of "non-delegable waters", which include all tidal waters shoreward to the mean high water mark and all wetlands partially or totally within 1000 feet of mean high tide. A jurisdictional determination would need to be made by USACE whether the intake canal are waters of the US and if the activities proposed to encroach wetlands within 1000 feet of the intake canal require a Section 404 permit.

5.4.2 U.S. Environmental Protection Agency

NJDEP is delegated the authority to implement the final Clean Water Act Section 316(b) Phase II USEPA regulations through NJPDES permits. The national performance standards that must be achieved are a reduction in impingement mortality for all life stages of fish and shellfish by 80 to 95 percent and a reduction in entrainment for all life stages of fish and shellfish by 60 to 90 percent.

While a closed-cycle recirculating cooling tower system is a technology USEPA has determined always achieves the national performance standards, USEPA allows facilities to demonstrate compliance with existing and/or future design and construction technologies and operational measures.

In accordance with the Rule, if recirculating cooling towers are installed at OCGS (Compliance Alternative 1i) the station has met the requirements of the Rule. Recirculating systems usually achieve a flow reduction on the order of 90 to 95 percent. However, the flow reduction from 980,000 gpm (the existing once-through system accounting for flow reductions) to 280,000 gpm (new closed-cycle system) is 71.4 percent, which is less of a reduction than what would be expected from a closed-cycle cooling system.

With an efficacy of 71.4 percent, the national performance standard for entrainment (60 to 90 percent reduction) is achieved strictly by flow reduction with cooling towers, but it is questionable if the standard for impingement mortality (80 to 95 percent reduction) would be achieved. For the protection of impingeable organisms at the circulating water system intake structure, the traveling screens at the intake were previously upgraded with modified Ristroph screens and an improved marine life handling system. This system is the best technology available (BTA). Although the total reduction in impingement mortality at the circulating water intake after the installation of cooling towers (that is, the reductions from the existing system plus cooling towers) may approach zero, the reductions attributable to the cooling towers alone would be very small and change existing conditions little. There are no screens at the dilution/bypass water intake structure and, therefore, no impingement controls. Flow reductions from cooling towers would decrease flow 50 percent at the dilution pumps with a concurrent reduction in the pass-through of impingeable-size organisms.

In summary, the existing circulating water system already achieves BTA for the reduction of impingement mortality and there would be a very small improvement in reducing the mortality of impingeable-size organisms. The national performance standard for impingement mortality (80 to 95 percent reduction) of impingeable-size organisms might not be achieved with the selected conceptual model.

USEPA views entrainment reduction as directly related to flow reduction, and, while rates of impingement are not as directly attributable to water withdrawal rates as entrainment, the Rule preamble (69 FR 41612, col. 2) states: *"EPA agrees that reducing intake by installing flow reduction technologies will result in a similarly high reduction of impinged and entrained organisms..."*

With the existing plant configuration, OCGS achieves, or nearly achieves, the national performance standards for entrainment through Compliance Alternative 5. Cooling towers would not enable OCGS

to comply with the Rule any more effectively and efficiently than it does at present. Consequently, there would be very little to be gained by installing cooling towers. In spite of new technologies that have evolved since 1994, the analysis conducted in this report confirms the conclusions of studies conducted in support of the 1994 NJPDES permit that cooling towers are not an effective option at OCGS.

OCGS will comply with the USEPA Phase II Rule by optimizing the existing system to achieve the greatest efficacy as practicable with Compliance Alternative 5. The major means of reducing entrainment at OCGS is from the operation of the dilution pumps that have a great efficacy for entrainment survival. Entrainment, and impingement mortality, will be reduced by implementing operational controls/flow reduction at the dilution pumps. Performing habitat restoration actions will provide an additional margin for meeting the objectives of the Phase II Rule.

5.5 ADDITIONAL UNKNOWN ENVIRONMENTAL CONCERNS

There are other environmental issues not covered in the preceding discussions. These issues bring with them uncertainties regarding scope, cost, impact, and hindrance to obtaining permits and approvals. Some of these issues are:

- The zoning ordinance of Lacey Township identifies a "historic district" about one mile north of the intake canal. This district is not listed on the National or New Jersey Registers of Historic Places. However, it may be eligible for listing. If so, the visual impacts of the cooling towers to this district might need to be assessed and the public response to finding an adverse impact is unknown.
- Previous rare, threatened and endangered species (RTE) surveys suggest that habitat suitable for state threatened animal species (Pine Barrens tree frog, northern pine snake, wood turtle, barred owl, and Cooper's hawk) and rare wetland plant species (New Jersey rush, Pine Barrens boneset, curly grass fern) may occur on-site (Wildlife Habitat Council, 2005). RTE species and habitat assessments would need to be conducted and the constraints imposed by the identification of on-site RTE species or critical habitats are unknown.
- The U.S. Fish and Wildlife Service manages the Edwin B. Forsythe National Wildlife Refuge. The open land east of and immediately adjacent to Eno's Pond County Park in Lacey Township, about two miles northeast of the proposed cooling towers, is part of the Barnegat Division of the Refuge. The potential impact of cooling tower emissions to the vegetation and wildlife of the nearby Refuge is unknown.

5.6 REGULATORY REVIEW TIME AND SCHEDULE

Jurisdictional and permit review times vary with each type of application. Time frames in the cooling tower project schedule include application preparation (including technical support studies), administrative review for application completeness, and technical agency review of administratively complete applications. Temporal limitations would be placed on the field work related to wetlands and RTE surveys. At the minimum, these permits or activities would be necessary:

- CAFRA permit
- Waterfront Development jurisdictional determination
- CZM Consistency Statement
- Coastal Wetlands jurisdictional determination
- Letter of Interpretation (freshwater wetlands and transition areas)
- Section 10 and Section 404 jurisdictional determination from USACE

- Nonconforming land use variance
- Fence variance
- Public hearings
- Air quality PSD preconstruction permit
- Air quality minor source preconstruction permit
- Sediment Erosion and Sediment Control Plan approval
- NJPDES permit for stormwater discharges from construction activities
- DCA release

The regulatory process will involve coordination and agreement amongst various divisions and bureaus of these entities:

- Lacey Township
- Ocean Township
- New Jersey Department of Environmental Protection
- New Jersey Department of Community Affairs
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service
- National Park Service
- Nuclear Regulatory Commission
- Ocean County Planning Board
- Ocean County Soil Conservation District

Permits and approvals must be issued before construction can begin. Some permits require prior approval by other regulatory entities. For example, USACE permits require an NJDEP determination that the project is consistent with New Jersey's CZM rules. The first regulatory action that must be obtained is USNRC relicensing of OCGS. Considering the environmental regulatory issues that surround the towers, URS expects that at least two years must be allowed for regulatory approvals. Construction would be a minimum of three years. A closed-cycle cooling system at OCGS would not be likely to be operational until 2012 to 2014 (at the earliest).

This study evaluated the applicability of cooling towers as a Clean Water Act Section 316(b) Phase II Rule compliance technology for OCGS. A thorough examination of the best technologies available, and applicable within constraints unique to OCGS, indicates that there is no measurable gain in installing cooling towers (see Section 5.4.2). OCGS currently achieves, or nearly achieves, the national performance standards for entrainment reduction and cooling towers do little to improve upon that. Though OCGS would comply with the Rule if it installs cooling towers, it would not achieve a biological efficacy of reductions in impingement mortality that is the intent of the Rule. Any benefit of cooling towers would be offset by numerous disadvantages.

In addition, cooling towers at OCGS might not be able to be permitted and the cost would be greater than USEPA costs by a factor of 8.9 to 10.1. The applicable standard for assessing the costs of compliance with the Phase II Rule is whether the costs are "significantly greater" than USEPA costs (not whether such costs are "wholly disproportionate"). In this case, the costs are both significantly greater and wholly disproportionate.

The factors that lead us to conclude that cooling towers are unlikely to be available at OCGS are:

- CAFRA impervious surface cover limits might not be met.
- PSD ambient air quality particulate matter increments, NAAQS, and NJAAQS might not be met.
- More stringent Class I area PSD requirements would need to be met at the Brigantine National Wildlife Refuge.
- Increased air emissions at fossil-fuel fired plants replacing the lost generation at OCGS.
- Increased once-through cooling water usage at fossil-fuel fired plants replacing the lost generation at OCGS.
- The current facility is a nonconforming use. Visual, noise, and traffic impacts might prevent this project from receiving Lacey Township variances.
- There would be a very small improvement in reducing the mortality of impingeable-size organisms. The national performance standard for impingement mortality (80 to 95 percent reduction) of impingeable-size organisms might not be achieved
- Additional flow reduction and entrainment reduction would be less (71.4 percent) with cooling towers than what would be expected from a closed-cycle cooling system (90 to 95 percent). Compared to the current plant configuration, cooling towers would not enable OCGS to comply with the Rule any more effectively and efficiently than it does at present.
- Costs are both significantly greater than and wholly disproportionate to USEPA costs.

Furthermore, the installation of cooling towers at OCGS is an instance where a technology may be possible, but its actual implementation is not practicable. In addition to the major factors of unavailability listed above, there are other matters of construction logistics and practicality that should be considered. Since OCGS was not originally designed to accommodate cooling towers, their construction would require extensive modifications to existing systems and structures to retrofit the current plant design to adopt the cooling tower technology. For example, the relining of the existing cooling water system flumes would be a very difficult procedure that would involve welding in very confined spaces; the placement of the massive 12-foot diameter underground conduits would entail maneuvering in and around complex systems of existing underground electrical wiring and pipelines while providing extensive dewatering; and the removal and replacement of massive water boxes would involve demolition, scaffolding, additional radiation controls, and heavy lift equipment within the existing turbine building.

URS has concluded that the best cooling tower technology available at OCGS to reduce consumptive water use, and effectively eliminate a visible plume and ground fog, is a recirculating closed-cycle cooling system with two multi-cell mechanical hybrid fiberglass cooling towers arranged in two rows.

Considering the regulatory issues that must be resolved prior to construction (if environmental permitting of such a structure is even possible), and the complexity of construction, the time to implement a cooling tower alternative at OCGS would be extremely lengthy. The construction of this system is not warranted and, because it might not be able to be permitted, is effectively unavailable under the Phase II 316(b) Rule. Moreover, the costs associated with retrofitting the plant to construct and operate a cooling tower system is wholly disproportionate to and significantly greater than USEPA's presumed costs.

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TABLES

Table 1

Comparison of Potential Cooling Towers Systems for Oyster Creek Generating Station

Item	Linear Mechanical Draft	Round Mechanical Draft	Natural Draft	Dry Air-Cooled Condenser	Linear Hybrid [1]
Cost	base	2 x base	minimum of 2.5 x base	6 x base	2 to 3 x base
Constructability	base	longer	much longer	much longer	longer
Water Use	base	base	slightly less	none	less
Land Area	base	slightly more	slightly more	much more	base
Ground Fog	yes	yes	less	none	controlled to none
Noise Without Added Silencing	base	slightly less	slightly less	more	slightly more
Summer Season Steam Turbine Power	base	base	base	much lower	base
Average Season Steam Turbine Output	base	base	slightly higher	slightly lower	close to base
Tower Power Consumption	base	slightly less	none	slightly more	slightly more
Circulation Water Power Use	base	base	base	none	slightly more
Elevation to Top of Tower	62 feet	62 feet	600 feet	130 feet	80 feet
Water Treatment	base	base	base	none	base
Consumptive Water Use	base	base	slightly lower	none	lower
Cycles of Concentration	base	base	base	not applicable	base

[1] Round hybrid design not offered by vendors.

Table 2

Summary of Net Power Reduction
for Oyster Creek Generating Station

Item	Units	Notes	Winter	Spring	Summer	Fall	Winter Capacity	Summer Capacity
Ambient conditions								
Ambient Dry Bulb	°F	1	36.0	50.0	72.1	57.7	20.0	87.0
Ambient Wet bulb	°F	1	31.4	44.2	62.0	49.8	17.1	77.0
LP STG output with once-through cooling								
Inlet cooling water temperature	°F	2,9	39.9	55.0	79.0	62.0	34.9	83.7
Exhaust Back Pressure	In Hg A	9	0.928	1.163	2.295	1.421	0.805	2.615
Net LP Steam Turbine Output	kW	3	404,837	404,954	387,683	403,321	404,710	380,065
Circulating Water Pump Load	kW	4	2,663	3,551	3,551	3,551	2,663	3,551
Dilution Pump Load	kW	4	2,676	2,676	2,676	2,676	2,676	2,676
Net Plant output	kW		**399,498**	**398,727**	**381,456**	**397,094**	**399,371**	**373,838**
LP STG output with hybrid cooling towers								
Mode of Operation			Wet -Dry	Wet -Dry	Wet	Wet -Dry	Wet -Dry	Wet
Inlet cooling water temperature	°F	9	77.2	82.8	76.9	85.5	70.7	86.1
Exhaust Back Pressure	In Hg A	9	2.185	2.555	2.162	2.747	1.819	2.793
Net LP Steam Turbine Output	kW	3	390,161	381,722	390,708	377,137	397,733	376,061
Cooling Tower Fan Load	kW		6,823	6,840	6,398	6,837	6,785	6,391
Circulating Water Lift Pump	kW	5	8,955	8,955	8,955	8,955	8,955	8,955
Circulating Water Pump Load	kW	6	5,970	5,970	5,970	5,970	5,970	5,970
Dilution Pump Load	kW	8	1,338	1,338	1,338	1,338	1,338	1,338
Make-up Water Pump		7	204	234	252	322	169	346
Net Plant output	kW		**366,872**	**358,385**	**367,795**	**353,715**	**374,516**	**353,061**
Net loss in output	kW		[redacted]					

Notes

Rev 00 January 16, 2006

1 Ambient temp from NOAA data for Atlantic City
2 Intake temp Oyster Creek daily recordings from July, 1984 through Jan 2000
3 LP turbine output calculated from Thermoflow's GTMaster simulation program set to for a GE six flow 38 inch LRB exhaust end.
4 Pump operating characteristics from Pump Flow History Rev 5, 1994 to 2003
5 Cooling Tower Lift Head **75** feet
6 Circulation Pump head **50** feet
7 Make-up Water Pump head **100** feet
8 One dilution pump operating with hybrid cooling tower

Rev 01 February 20, 2006

9 Added back pressure and inlet cooling water references

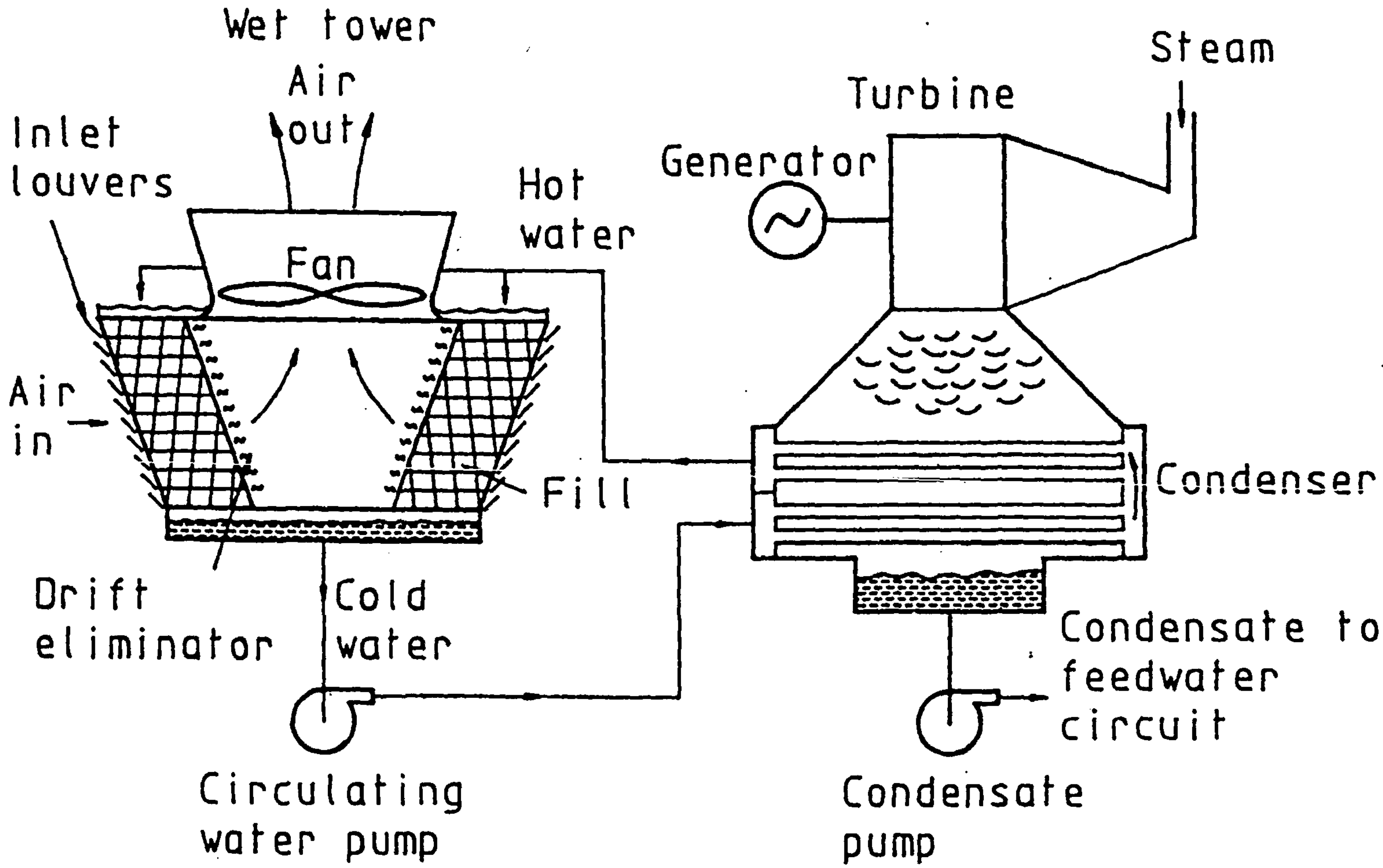
Table 3

Summary of Estimated Capital and Operating Costs for Oyster Creek Generating Station

Item	Effective Period	First Year Cost	Labor	Material	Lost Revenue	Added Cost	Total Cost Range	
							Low Risk	High Risk
Construction	initial		$212,195,165	$150,537,481			$362,732,645	$362,732,645
Lost Capacity Revenue	Life time				$7,086,997		$7,086,997	$7,086,997
Lost Energy Revenue	Life time				$108,431,185		$108,431,185	$108,431,185
Lost Capacity during Outage	initial				$4,311,954		$4,311,954	$4,311,954
Lost Energy during Outage	initial				$80,411,211		$80,411,211	$80,411,211
Environmental/Public Relations	initial	$1,500,000				$1,500,000	$1,500,000	$1,500,000
Added Real Estate Taxes	Life time					$47,990,738	$47,990,738	$47,990,738
Dislocation of Master Plan	initial	$500,000				$500,000	$500,000	$500,000
Added Security Personnel	Life time	$1,000,000	$8,659,266				$8,659,266	$8,659,266
Added Operators	Life time	$900,000	$7,793,340				$7,793,340	$7,793,340
Added Insurance Cost	Life time	$18,000				$155,867	$155,867	$155,867
Maintenance/Chemicals	Life time	$36,000		$311,734		$10,628,580	$10,940,313	$10,940,313
Subtotal							$640,513,516	$640,513,516
Risk Factor							$64,051,352	$160,128,379
Total							**$704,564,868**	**$800,641,895**

FIGURES

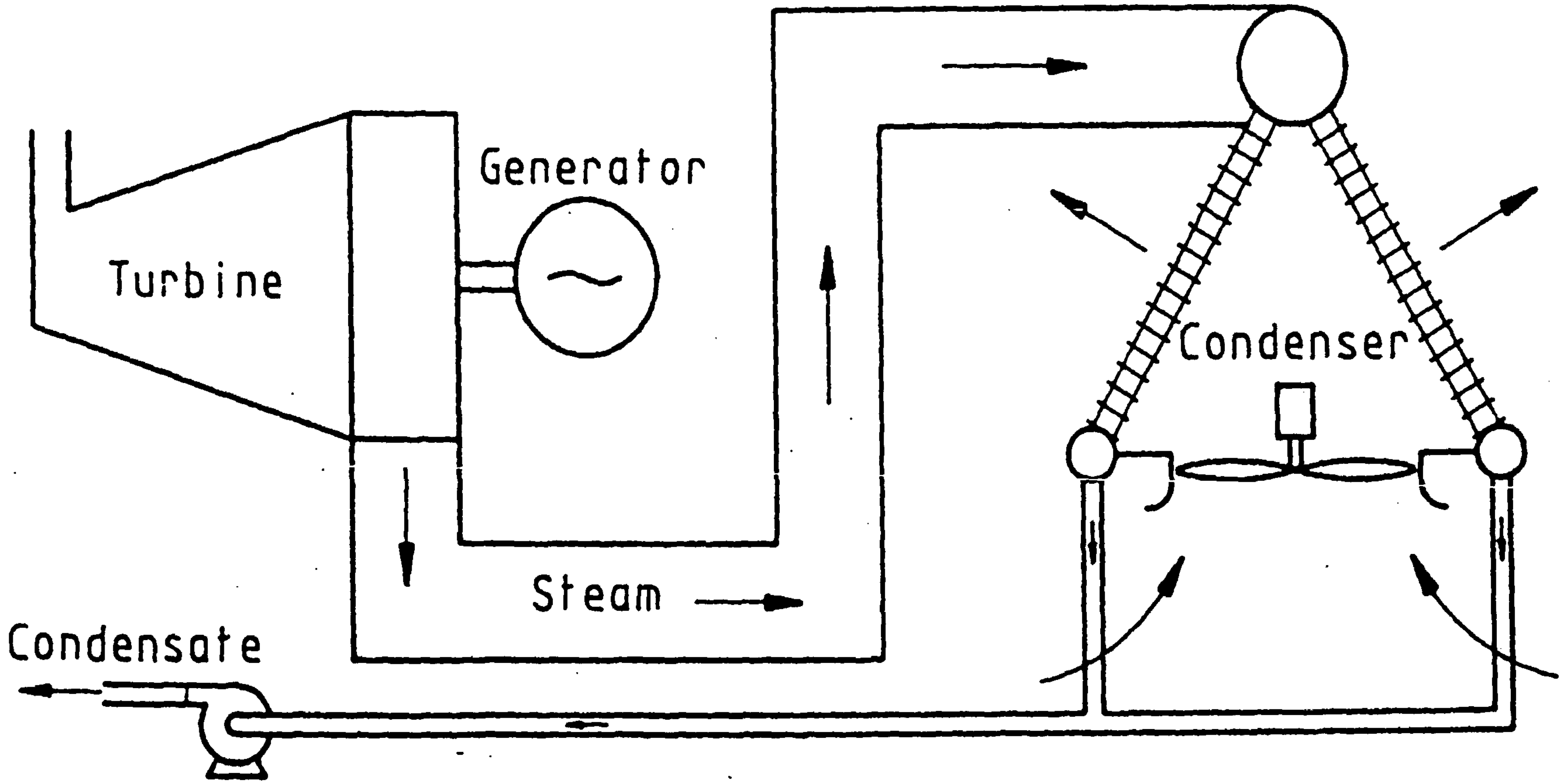
URS



Source: Kroger (1998)

Job No. 19996798	**Figure 1**
Prepared by: CYC	**Wet Evaporative Cooling**
Date: Feb. 28, 2006	**Determination of Cooling Tower Availability at Oyster Creek Generating Station**

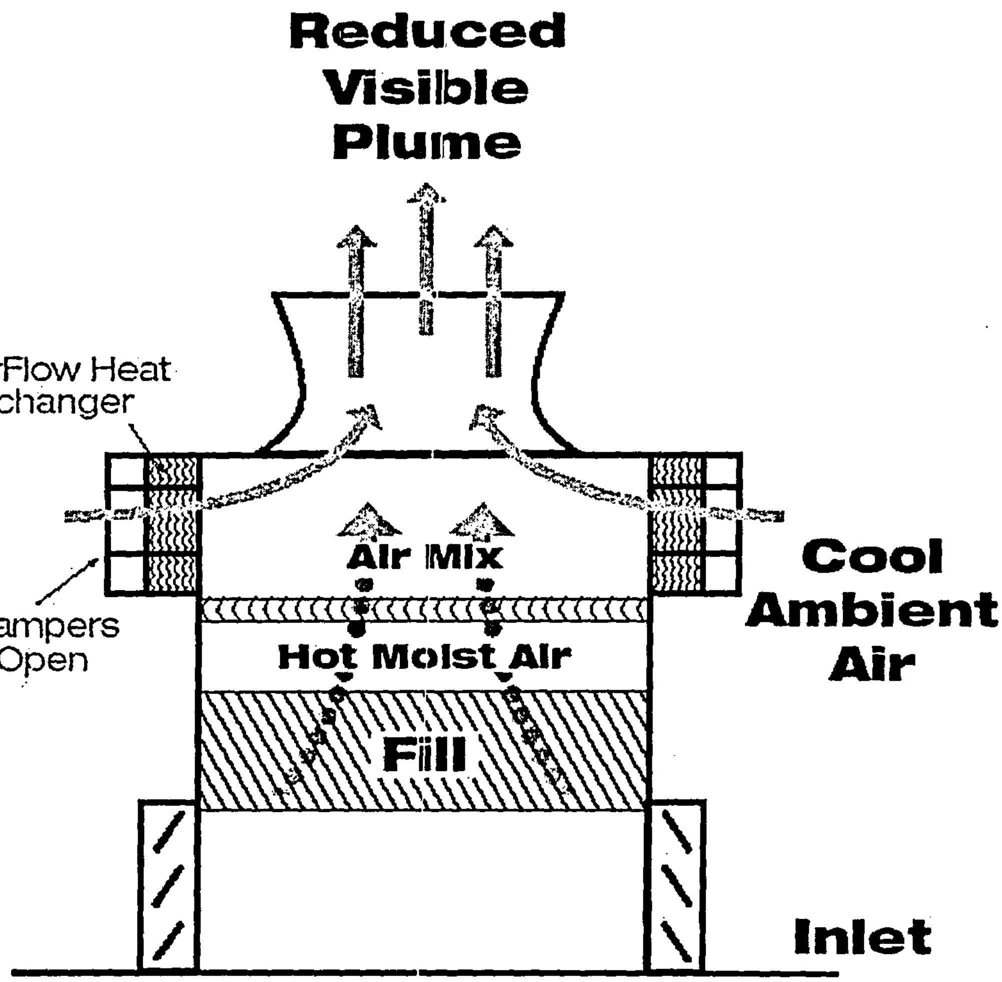
URS



Source: Kroger (1998)

Job No. 19996798	**Figure 2** **Direct Dry Cooling** **Determination of Cooling Tower Availability at Oyster Creek Generating Station**
Prepared by: CYC	
Date: Feb. 28, 2006	

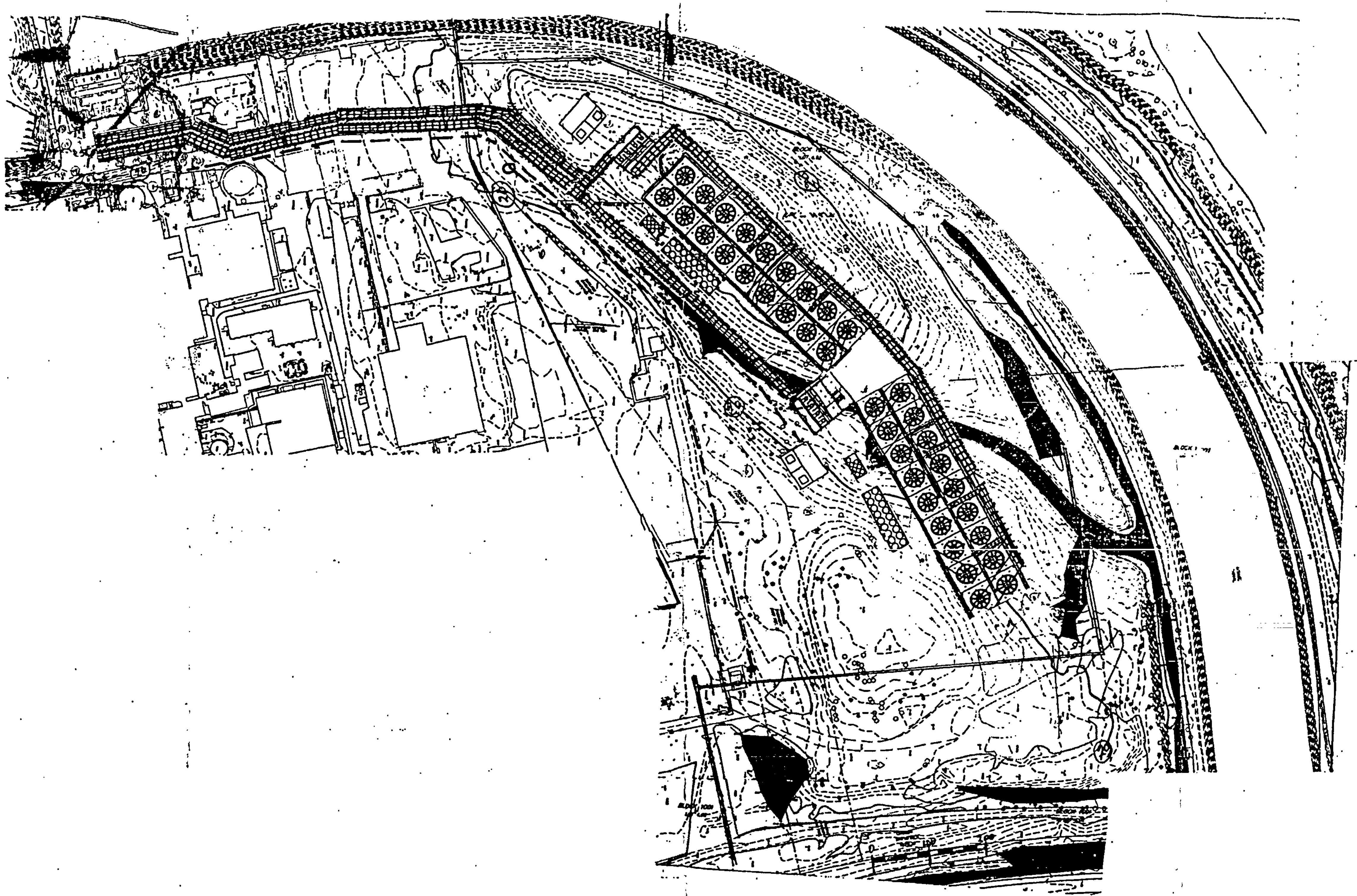
URS



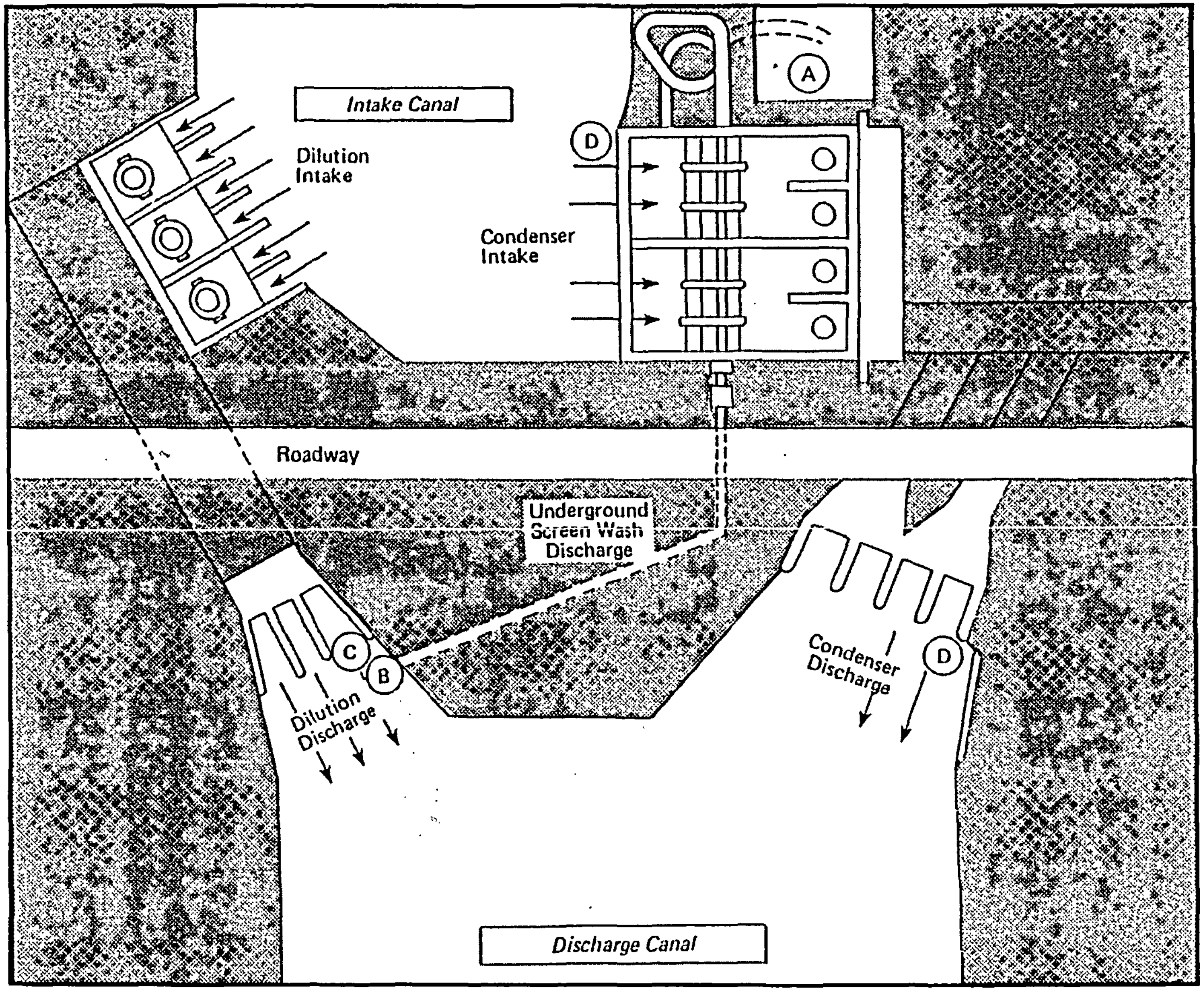
The Marley ClearFlow System

Source: Marley (1998)

Job No. 19996798	**Figure 3** **Hybrid Cooling** **Determination of Cooling Tower Availability at Oyster Creek Generating Station**
Prepared by: CYC	
Date: Feb. 28, 2006	



Job No. 19996798	**Figure 4**
Prepared by: CYC	**Conceptual Layout**
Date: Feb. 28, 2006	**Determination of Cooling Tower Availability at Oyster Creek Generating Station**

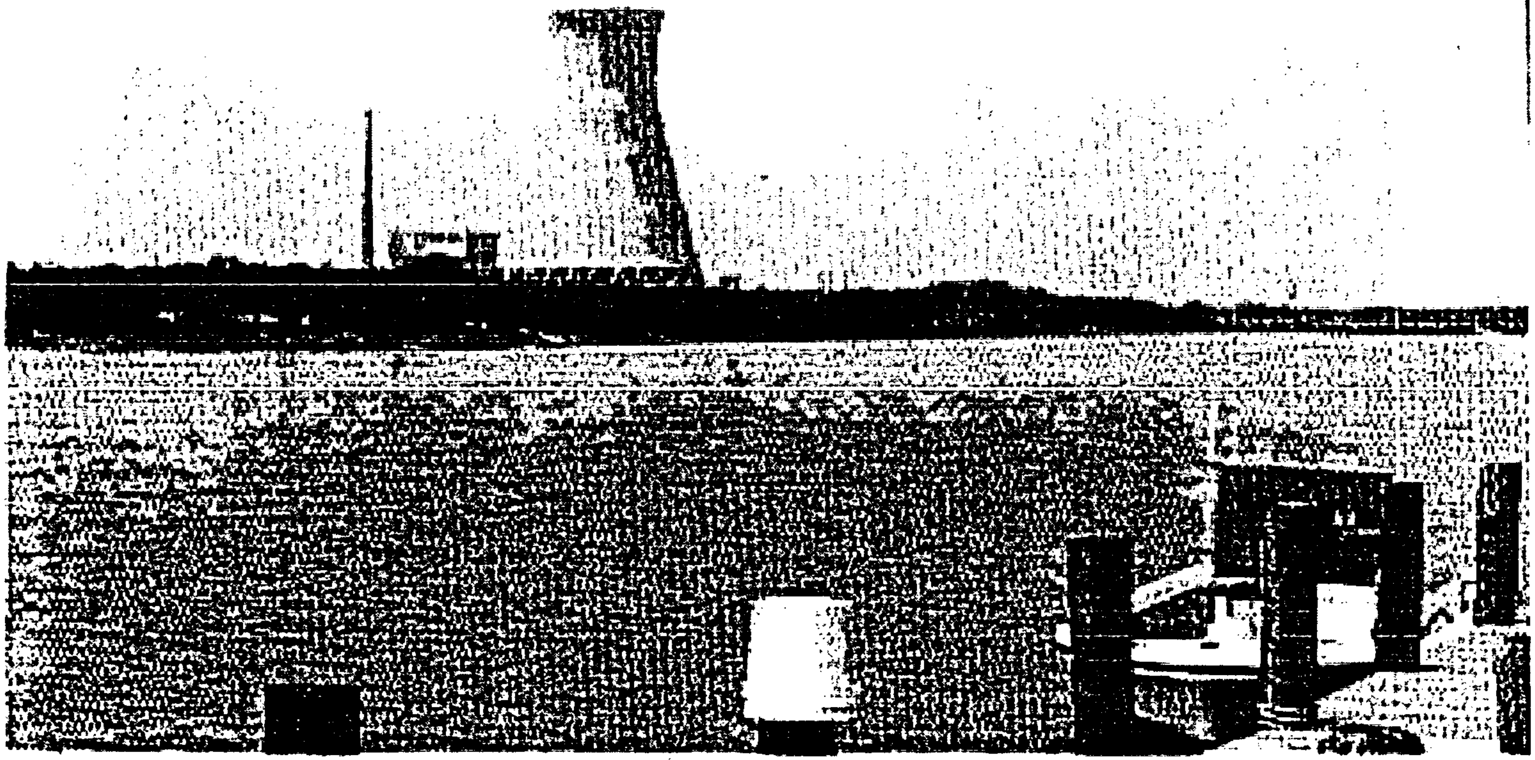


Source: AmerGen (2005)

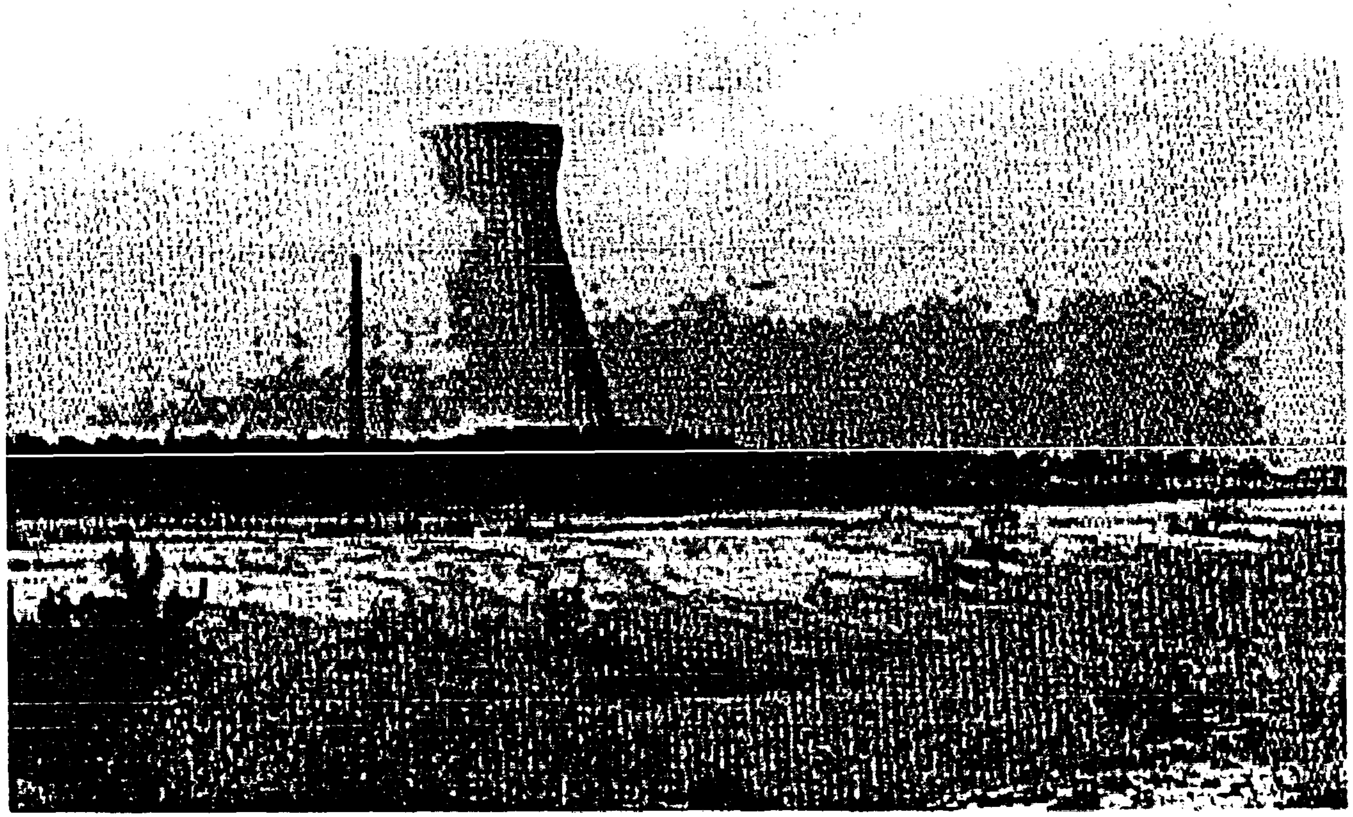
Job No. 19996798	**Figure 5** **Intake and Discharge of the Circulating Water System and Dilution/Bypass Water System** **Determination of Cooling Tower Availability at Oyster Creek Generating Station**
Prepared by: CYC	
Date: Feb. 28, 2006	

APPENDIX A

EBASCO (1992b) VISUAL ANALYSIS



LOCATION No. 6 - VIEW FROM BERMUDA DR. SOUTH OF NANTUCKET RD.



LOCATION No. 7 - VIEW FROM CAPE COD DR. SOUTH OF NANTUCKET RD.

APPENDIX B

CAPITAL AND OPERATING COST ANALYSIS

Oyster Creek Generating Station

Cooling Tower Study

Construction Cost Estimate Summary

Item No.	DESCRIPTION	QUANTITY	Unit of Measure	Labor Unit Cost ($)	Material / Equipment Unit Cost ($)	Material / Equipment Cost ($)	Total Labor Cost ($)	Total Material Equipment and Labor ($)	Item Total Cost ($)
1	SITE PREPARATION								
	Mobilization	1	LM			$100,000		$100,000	
	Grub stomps and remove	15	Acres	2975			$44,625	$44,625	
	Cut and chip trees up to 24-inch dia.	6	Acres	11100			$66,600	$66,600	
	Excavation above elevation 20 ft.	195750	CY	2.92			$571,590	$571,590	
	Backfill below elevation 20 feet	168750	CY	1.19			$200,813	$200,813	
	Load and haul spoils	25000	CY	15			$375,000	$375,000	
	Grading Large Area	72600	SY	0.64			$46,464	$46,464	
	ITEM TOTALS					$100,000	$1,305,092	$1,405,092	$1,405,092
2	EROSION & SEDIMENTATION CONTROL								
	Silt fences	20000	LF	1.09			$21,800	$21,800	
	Excavation Retention Ponds	6667	CY	2.92			$19,467	$19,467	
	Cut Drainage trenches	2000	CY	2.83			$5,660	$5,660	
	Embankment for dams	889	CY	5.9			$5,244	$5,244	
	Riprap	419	SF	79.5			$33,301	$33,301	
	36-Inch Dia CMP Pipe	419	CL	384			$160,850	$160,850	
	12-Inch Dia CMP Pipe underground	3000	LF	384			$1,152,000	$1,152,000	
	Geosyntheics	2000000	SF	3.75			$7,500,000	$7,500,000	
	Storm Runoff Culverts	4000	LF	180			$720,000	$720,000	
	ITEM TOTALS					$0	$9,618,322	$9,618,322	$9,618,322
3	RELOCATION EXISTING UTILITIES								
	Security conduits								
	Yard Lightning								
	Telephone								
	Storm Drainage Lines								
	Power supply feeders								
	Computer Cables								
	Fire Protection Lines								
	Hydrants								
	Sewage								
	concrete retention walls								
	sheet pile Shoring temporary / structures								
	Safety Related piping system								
	Service water piping system								
	ESTIMATED ITEM TOTALS					$3,200,000	$4,800,000	$8,000,000	$8,000,000
4	NEW ELECTRICAL TRANSMISSION LINES								
	Interconnection with Plant Switch yard		U			$600,000	$400,000	$1,000,000	
	480 VOLT Switchgear/MCC Enclosure Makeup Supply					$1,001,189	$544,414	$1,545,603	
	480 VOLT Switchgear/MCC Enclosure Makeup Supply					$282,338	$46,666	$329,004	
	34.5 KV Substation					$1,238,168	$326,530	$1,564,698	
	5 KV Switchgear/MCC Enclosure					$1,089,502	$445,303	$1,534,805	
	Relocation of Overhead 34.5 KV Lines					$141,402	$799,674	$941,076	
	ITEM TOTALS					$4,352,599	$2,562,587	$6,915,186	$6,915,186
5	RELOCATION OF EXISTING BUILDINGS AND SERVICES IN CT AREA								
	ESTIMATED ITEM TOTALS					$400,000	$600,000	$1,000,000	$1,000,000
6	CONDENSER WATER BOX UPGRADE								
	Water Box	12	U	Total for 12		$690,000	$862,500	$1,552,500	
	72 Inch Butter fly valves	6	U	72	$80,974	$485,844	$15,000	$500,844	
	60 Inch Butter fly valves	6	U	60	$42,354	$254,124	$15,000	$269,124	
	42 Inch Butter fly valves	3	U	42	$16,820	$50,460	$7,500	$57,960	
	Installation of Water Boxes	12	U			$0	$900,000	$900,000	
	Refurbish CW pipe at Condenser		L	120	525	$63,000	$126,000	$189,000	
	Removal of knockout wall					$225,000		$225,000	
	Removal / Disposal of existing Water Boxes						$345,000	$345,000	
	ITEM TOTALS					$1,768,428	$2,271,000	$4,039,428	$4,039,428
7	TRANSITION FROM FLUMES TO PCCP								
	Concrete Outside Walls	123	CY	180			$22,080	$22,080	
	Concrete Front walls	61	CY	500			$30,667	$30,667	
	concrete Intermediate walls	92	CY	500			$45,833	$45,833	
	Concrete back wall	61	CY	500			$30,667	$30,667	
	Concrete top / bottom slab	64	CY	500			$31,944	$31,944	
	Concrete Mud Mat	128	CY	500			$63,889	$63,889	
	interconnecting Steel pipe and manifold	276	SF	200			$55,200	$55,200	
	Man ways	2	U	10000			$20,000	$20,000	
	Excavation	1704	CY	25			$42,593	$42,593	
	Backfill	639	CY	25			$15,972	$15,972	
	Load and haul spoils	1065	CY	20			$21,296	$21,296	
	sheet pile temporary	6000	SF	25			$150,000	$150,000	
	Dewatering Allowance	100	DAY	2000			$200,000	$200,000	
	solution grouting	5556	CY	75			$416,667	$416,667	
	Pile foundations	900	LS	315			$283,500	$283,500	
	Concrete Pile caps	36	CY	500			$17,778	$17,778	
	ITEM TOTALS					$0	$1,448,086	$1,448,086	$1,448,086

Oyster Creek Generating Station

Cooling Tower Study

Construction Cost Estimate Summary

Item No.	DESCRIPTION	QUANTITY	Unit of Measure	Labor Unit Cost ($)	Material / Equipment Unit Cost ($)	Material / Equipment Cost ($)	Total Labor Cost ($)	Total Material Equipment and Labor ($)	Item Total Cost ($)
8	RELINING OF EXISTING CWS FLUMES								
	Cold water supply flume liners	625000	pounds	4.25			$2,656,250	$2,656,250	
	Warm Water Return liners	1250000	Pounds	4.25			$5,312,500	$5,312,500	
	Wall Inserts & supports	625000	Pounds	4.25			$2,656,250	$2,656,250	
	Surface Preparation (sandblasting)	80000	SF	84.25			$6,740,000	$6,740,000	
	Reinforced Concrete Plugs	74	CY	500			$37,037	$37,037	
	Dewatering Allowance	30	DAYS	2000			$60,000	$60,000	
	Ventilation / Illumination	100000	LS $	1			$100,000	$100,000	
	Grouting	42000	SF	8.55			$359,100	$359,100	
	Welding	25000	LF	84			$2,100,000	$2,100,000	
	ITEM TOTALS					$0	$20,021,137	$20,021,137	$20,021,137
9	CWS PIPELINES Sta 0 to sat 500								
	Excavation, Trench STA 0 to STA 100	2963	CY	50		$0	$148,148	$148,148	
	Backfill, Trench bedding, Granular	30	CY	50		$0	$1,481	$1,481	
	Backfill, Trench initial, floable fill	741	CY	150		$0	$111,111	$111,111	
	Backfill, Trench final, on site material	474	CY	50		$0	$23,704	$23,704	
	Excavation, Trench STA 100 to STA 200	1667	CY	40		$0	$66,667	$66,667	
	Backfill, Trench bedding, Granular	30	CY	40		$0	$1,185	$1,185	
	Backfill, Trench initial, floable fill	741	CY	150		$0	$111,111	$111,111	
	Backfill, Trench final, on site material	67	CY	40		$0	$2,667	$2,667	
	Excavation, Trench STA 200 to STA 500	896	CY	30		$0	$26,889	$26,889	
	Backfill, Trench bedding, Granular	30	CY	30		$0	$889	$889	
	Backfill, Trench initial, floable fill	474	CY	150		$0	$71,111	$71,111	
	Backfill, Trench final, on site material	7	CY	30		$0	$222	$222	
	Load and haul spoils	133	CY	20		$0	$2,667	$2,667	
	144-inch Dia CW Pipe - Underground PCCP	1000	LF		2149	$2,149,000	$0	$2,149,000	
	Pipeline Epoxy Coatings (10 % x 2)	1000	LF		429.8	$429,800	$0	$429,800	
	Pipeline Installation (25 %)	1000	LF	537.25		$0	$537,250	$537,250	
	Dewatering Allowance	15	DAY		2000	$30,000	$0	$30,000	
	sheet pile Shoring temp Sta 0 to sta 100	9000	SF	15	20	$180,000	$135,000	$315,000	
	sheet pile Shoring temp Sta 100 to sta 200	7000	SF	15	20	$140,000	$105,000	$245,000	
	sheet pile Shoring temp Sta 200 to sta 500	15000	SF	15	20	$300,000	$225,000	$525,000	
	Pile foundations for transition	6000	LS	315			$1,890,000	$1,890,000	
	Concrete Pile caps	237	CY	500			$118,519	$118,519	
	ITEM TOTALS					$3,228,800	$3,578,620	$6,807,420	$6,807,420
10	CWS PIPELINES Sta 500 to sta 1000								
	Excavation, trapezoidal Trench	67222	CY	25		$0	$1,680,556	$1,680,556	
	Backfill, Trench bedding, Granular	51	CY	25		$0	$1,274	$1,274	
	Backfill, Trench initial, floable fill	1289	CY	120		$0	$154,738	$154,738	
	Backfill, Trench final, on site material	522	CY	25		$0	$13,056	$13,056	
	Load and haul spoils	65	CY	25		$0	$1,630	$1,630	
	144-inch Dia CW Pipe - Underground PCCP	1000	LF		1574	$1,574,000	$0	$1,574,000	
	Pipeline Epoxy Coatings (10 % x 2)	1000	LF		314.8	$314,800	$0	$314,800	
	Pipeline Installation (25 %)	1000	LF	393.5		$0	$393,500	$393,500	
	Dewatering Allowance	15	DAY		2000	$30,000	$0	$30,000	
	Anchor Blocks concrete	1157	CY	500		$0	$578,704	$578,704	
	ITEM TOTALS					$1,918,800	$2,823,456	$4,742,256	$4,742,256
11	CWS PIPELINES Sta 1000 to sta 1600								
	Excavation, Trench	39600	CY	25		$0	$990,000	$990,000	
	Backfill, Trench bedding, Granular	27	CY	25		$0	$681	$681	
	Backfill, Trench initial, floable fill	910	CY	120		$0	$109,227	$109,227	
	Backfill, Trench final, on site material	12	CY	25		$0	$300	$300	
	Load and haul spoils	16	CY	25		$0	$389	$389	
	144-inch Dia CW Pipe - Underground PCCP	600	LF		1574	$944,400	$0	$944,400	
	Pipeline Epoxy Coatings (10 % x 2)	600	LF		314.8	$188,880	$0	$188,880	
	Pipeline Installation (25 %)	600	LF	393.5		$0	$236,100	$236,100	
	Dewatering Allowance	15	DAY		2000	$30,000	$0	$30,000	
	Anchor Blocks concrete	250	CY	500		$0	$125,000	$125,000	
	ITEM TOTALS					$1,163,280	$1,461,697	$2,624,977	$2,624,977
12	CT HEADER PIPE Sta 1000 to sta 1600								
	Excavation, Trench	33778	CY	25		$0	$844,444	$844,444	
	Backfill, Trench bedding, Granular	5	CY	25		$0	$130	$130	
	Backfill, Trench initial, floable fill	853	CY	120		$0	$102,400	$102,400	
	Backfill, Trench final, on site material	11	CY	25		$0	$278	$278	
	Load and haul spoils	13	CY	25		$0	$315	$315	
	144-inch Dia CW Pipe - Underground PCCP	600	LF		1574	$944,400	$0	$944,400	
	Pipeline Epoxy Coatings (10 % x 2)	600	LF		314.8	$188,880	$0	$188,880	
	Pipeline Installation (25 %)	600	LF	393.5		$0	$236,100	$236,100	
	Dewatering Allowance	15	DAY		2000	$30,000	$0	$30,000	
	Anchor Blocks concrete	250	CY	500		$0	$125,000	$125,000	
	ITEM TOTALS					$1,163,280	$1,308,667	$2,471,947	$2,471,947
13	COOLING TOWER RISERS								
	cooling tower risers (steel pipe)	280800	Pounds	1.75	2.75	$772,200	$491,400	$1,263,600	
	Flow control Valves	36	U	10000		$360,000		$360,000	
	Combining Tees allowance	36	U	5000		$180,000		$180,000	
	ITEM TOTALS					$1,312,200	$491,400	$1,803,600	$1,803,600

Oyster Creek Generating Station

Cooling Tower Study

Construction Cost Estimate Summary

Item No.	DESCRIPTION	QUANTITY	Unit of Measure	Labor Unit Cost ($)	Material / Equipment Unit Cost ($)	Material / Equipment Cost ($)	Total Labor Cost ($)	Total Material Equipment and Labor ($)	Item Total Cost ($)
14	NEW COOLING TOWER PUMP HOUSE								
	Concrete Outside Wall	633	CY	500		$0	$316,667	$316,667	
	Concrete Outside wall	633	CY	500		$0	$316,667	$316,667	
	concrete Intermediate walls	700	CY	500		$0	$350,000	$350,000	
	Concrete back wall	267	CY	500		$0	$133,333	$133,333	
	Concrete bottom slab	2111	CY	500		$0	$1,055,556	$1,055,556	
	Concrete Mud Mat	1689	CY	250		$0	$422,222	$422,222	
	Excavation	19704	CY	25		$0	$492,593	$492,593	
	Backfill	1778	CY	25		$0	$44,444	$44,444	
	Load and haul spoils	17926	CY	25		$0	$448,148	$448,148	
	Dewatering Allowance	30	DAY	2000		$0	$60,000	$60,000	
	CRANE	1	U		100000	$100,000	$0	$100,000	
	Stop Logs	4	U		20000	$80,000	$0	$80,000	
	Handrail	250	LF		50	$12,500	$0	$12,500	
	Grating	4200	SF		45	$189,000	$0	$189,000	
	Pile foundations	6000	LF	315		$0	$1,890,000	$1,890,000	
	Concrete Pile caps	237	CY	500		$0	$118,519	$118,519	
	ITEM TOTALS					$381,500	$5,648,148	$6,029,648	$6,029,648
15	NEW CT CIRC PUMPS & MOTORS								
	4 CW Pumps 115,000 gpm at 50 ft at 1500 HP each								
	Total CW PUMP Flow is 460000 gpm								
	Calculated using $ 25 per gpm	4	U	100000	2875000	$11,500,000	$400,000	$11,900,000	
	Pump disch Steel pipe and manifold	233200	pounds	3.25	5.75	$1,340,900	$757,900	$2,098,800	
	Flow control valves 72-inch dia	4	U	60000	$80,974	$323,896	$240,000	$563,896	
	Decommissioning existing CW pumps								
	115,000 gpm pump/motors	4	U	400,000	$412,000	$360,000	$1,600,000	$1,960,000	
	Electrical switch yard	1	U	650,000	$167,375	$146,250	$650,000	$796,250	
	ITEM TOTALS					$13,671,046	$3,647,900	$17,318,946	$17,318,946
16	COOLING TOWER EARTH WORK								
	Excavation Cooling tower basin	42667	CY	25		$0	$1,066,667	$1,066,667	
	Backfill CT basin	1778	CY	25		$0	$44,444	$44,444	
	Load and haul spoils	40889	CY	20		$0	$817,778	$817,778	
	ITEM TOTALS					$0	$1,928,889	$1,928,889	$1,928,889
17	CT REINFORCED CONCRETE								
	CT basin lateral walls	1280	CY	500		$0	$640,000	$640,000	
	CT basin END walls	107	CY	500		$0	$53,333	$53,333	
	CT basin bottom slab	9600	CY	500		$0	$4,800,000	$4,800,000	
	Pile foundations	72000	LF	315		$0	$22,680,000	$22,680,000	
	Concrete Pile caps	2844	CY	500		$0	$1,422,222	$1,422,222	
	ITEM TOTALS					$0	$29,595,556	$29,595,556	$29,595,556
18	HYBRID COOLING TOWER								
	Basic Hybrid Tower	1	U		$21,700,000	$21,700,000	$14,700,000	$36,400,000	
	Lightening protection	1	U		$1,000,000	$596,154	$403,846	$1,000,000	
	Minimal Sound Suppression	12.5%	%	12.5%	$2,712,500	$1,617,067	$1,095,433	$2,712,500	
	Fire Suppression	6.0%	%	6.0%	$1,302,000	$776,192	$525,808	$1,302,000	
	ITEM TOTALS					$24,689,413	$16,725,087	$41,414,500	$41,414,500
19	MAKEUP & SIDE FILTERS								
	MAKEUP Filter Skids	2	U	750	$7,800,000	$7,800,000	$4,200,000	$12,000,000	
	Excavation	1852	CY	25		$0	$46,296	$46,296	
	Backfill	30	CY	25		$0	$741	$741	
	Bottom Slab	1067	CY	500		$0	$533,333	$533,333	
	Pile foundations	4800	LF	315		$0	$1,512,000	$1,512,000	
	Concrete Pile caps	24	CY	500		$0	$11,852	$11,852	
	ITEM SUBTOTAL					$7,800,000	$6,304,222	$14,104,222	
	SIDE Filter Skids	2	U	750	$2,925,000	$2,925,000	$1,575,000	$4,500,000	
	Excavation	533	CY	25		$0	$13,333	$13,333	
	Backfill	15	CY	25		$0	$370	$370	
	Bottom Slab	278	CY	500		$0	$138,889	$138,889	
	Pile foundations	1000	LF	315		$0	$315,000	$315,000	
	Concrete Pile caps	6	CY	500		$0	$2,963	$2,963	
	ITEM SUBTOTAL					$2,925,000	$2,045,556	$4,970,556	
	ITEM TOTALS					$10,725,000	$8,349,778	$19,074,778	$19,074,778
20	NEW CWS PUMP HOUSE								
	Concrete Outside Wall	844	CY	500		$0	$422,222	$422,222	
	Concrete Outside wall	844	CY	500		$0	$422,222	$422,222	
	concrete Intermediate walls	700	CY	500		$0	$350,000	$350,000	
	Concrete back wall	267	CY	500		$0	$133,333	$133,333	
	Concrete bottom slab	2111	CY	500		$0	$1,055,556	$1,055,556	
	Concrete Mud Mat	1689	CY	250		$0	$422,222	$422,222	
	Excavation	19704	CY	25		$0	$492,593	$492,593	
	Backfill	1778	CY	25		$0	$44,444	$44,444	
	Load and haul spoils	17926	CY	25		$0	$448,148	$448,148	
	Dewatering Allowance	30	DAY	2000		$0	$60,000	$60,000	
	CRANE	1	U		100000	$100,000	$0	$100,000	
	Stop Logs	4	U		20000	$80,000	$0	$80,000	
	Handrail	250	LF		50	$12,500	$0	$12,500	
	Grating	4200	SF		45	$189,000	$0	$189,000	
	Pile foundations	6000	LF	315		$0	$1,890,000	$1,890,000	
	Concrete Pile caps	237	CY	500		$0	$118,519	$118,519	
	ITEM TOTALS					$381,500	$5,859,259	$6,240,759	$6,240,759

Oyster Creek Generating Station

Cooling Tower Study

Construction Cost Estimate Summary

Item No.	DESCRIPTION	QUANTITY	Unit of Measure	Labor Unit Cost ($)	Material / Equipment Unit Cost ($)	Material / Equipment Cost ($)	Total Labor Cost ($)	Total Material Equipment and Labor ($)	Item Total Cost ($)
21	NEW CT LIFT PUMPS & MOTORS								
	4 CTwr Pumps: 115,000 gpm at 75 ft at 2500 HP each								
	Total CTwr Lift Pump Flow is 460000 gpm								
	Calculated using $ 25 per gpm	4	U	100000	2875000	$11,500,000	$400,000	$11,900,000	
	Pump disch Steel pipe and manifold	233200	pounds	3.25	5.75	$1,340,900	$757,900	$2,098,800	
	Flow control valves 72-inch dia	4	U	10000	$80,974	$323,896	$40,000	$363,896	
	ITEM TOTALS					$13,164,796	$1,197,900	$14,362,696	$14,362,696
22	CW MAKEUP SYSTEM								
	Dismantle Existing CW pumps	2	U		300000	$600,000	$0	$600,000	
	Dismantle CW Valves and Piping	2	U		150000	$300,000	$0	$300,000	
	Concrete Addition to install MU pump	53	CY	500		$0	$26,667	$26,667	
	30-inch HDPE pipeline	1500	LF	15	85	$127,500	$22,500	$150,000	
	Concrete Supports & anchors	593	CY	500		$0	$296,296	$296,296	
	Excavation, trapezoidal Trench	2047	CY	25		$0	$51,181	$51,181	
	Backfill, Trench bedding, Granular	2	CY	25		$0	$44	$44	
	Backfill, Trench initial, floable fill	20	CY	150		$0	$2,986	$2,986	
	Backfill, Trench final, on site material	13	CY	25		$0	$326	$326	
	Load and haul spoils	2	CY	20		$0	$44	$44	
	ITEM TOTALS					$1,027,500	$400,044	$1,427,544	$1,427,544
22	NEW CW MAKEUP PUMPS & MOTORS								
	2 Makeup Pumps: 10,000 gpm at 100 ft at 300 HP Each								
	Total CW PUMP Flow is 20,000 gpm								
	Calculated using $ 30 per gpm	2	LS $	10200	600000	$1,200,000	$20,400	$1,220,400	
	CW Pump discharge header	32600	pounds	3.25	5.75	$187,450	$105,950	$293,400	
	Pump Discharge Butterfly Valves	2	U	12500	$16,820	$33,640	$25,000	$58,640	
	Power supply & Controls	2	U		75000	$150,000	$0	$150,000	
	ITEM TOTALS					$1,571,090	$151,350	$1,722,440	$1,722,440
23	CWS BLOWDOWN SYSTEMS								
	BD Interconnection to CWS PCCP pipeline	114100	pounds	3.25	5.75	$656,075	$370,825	$1,026,900	
	BD Discharge Manifolds	58680	pounds	3.25	5.75	$337,410	$190,710	$528,120	
	Concrete Addition to install BD PIPELINE	356	CY	500		$0	$177,778	$177,778	
	30-inch HDPE pipeline	300	LF	15	85	$25,500	$4,500	$30,000	
	BD control Butterfly Valves	4	U		25000	$100,000	$0	$100,000	
	Excavation, trapezoidal Trench	3412	CY	25		$0	$85,301	$85,301	
	Backfill, Trench bedding, Granular	2	CY	25		$0	$44	$44	
	Backfill, Trench initial, floable fill	20	CY	150		$0	$2,986	$2,986	
	Backfill, Trench final, on site material	13	CY	25		$0	$326	$326	
	Load and haul spoils	2	CY	20		$0	$44	$44	
	ITEM TOTALS					$1,118,985	$832,515	$1,951,500	$1,951,500
25	ACCESS ROADS, PARKING & LAYDOWN AREAS								
	CT Access Roads								
	Subgrade preparation	2000	SY	1.47		$0	$2,940	$2,940	
	Compact Subgrade	2000	SY	0.78		$0	$1,560	$1,560	
	Geotextile Amoco 2016	2000	SY	0.13	0.82	$1,640	$260	$1,900	
	10" aggregate course - crushed stone	1333	SY	5.71	7.54	$10,053	$7,613	$17,667	
	Binder Course Asphalt 5" thick	1333	SY	7.13	8.9	$11,867	$9,507	$21,373	
	Guide Rail	1200	LF	25.57	5.39	$6,468	$30,684	$37,152	
	ITEM SUBTOTAL					$30,028	$52,564	$82,592	
	Security Fence peripheral Roads								
	Subgrade preparation	15556	SY	1.47		$0	$22,867	$22,867	
	Compact Subgrade	15556	SY	0.78		$0	$12,133	$12,133	
	Geotextile Amoco 2016	12444	SY	0.13	0.82	$10,204	$1,618	$11,822	
	10" aggregate course - crushed stone	12444	SY	5.71	7.54	$93,831	$71,058	$164,889	
	Binder Course Asphalt 5" thick	12444	SY	7.13	8.9	$110,756	$88,729	$199,484	
	Guide Rail	5600	LF	25.57	5.39	$30,184	$143,192	$173,376	
	ITEM SUBTOTAL					$244,975	$339,596	$584,572	
	Parking								
	Subgrade preparation	2500	SY	1.47		$0	$3,675	$3,675	
	Compact Subgrade	2500	SY	0.78		$0	$1,950	$1,950	
	Geotextile Amoco 2016	2167	SY	0.13	0.82	$1,777	$282	$2,058	
	10" aggregate course - crushed stone	2167	SY	5.71	7.54	$16,337	$12,372	$28,708	
	Binder Course Asphalt 2" thick	2167	SY	3.03	3.55	$7,692	$6,565	$14,257	
	ITEM SUBTOTAL					$25,805	$24,843	$50,648	
	Impervious area around CT basin								
	Subgrade preparation	13333	SY	1.47		$0	$19,600	$19,600	
	Compact Subgrade	13333	SY	0.78		$0	$10,400	$10,400	
	10" aggregate course - crushed stone	10667	SY	5.71	7.54	$80,427	$60,907	$141,333	
	Binder Course Asphalt 2" thick	10667	SY	3.03	3.55	$37,867	$32,320	$70,187	
	ITEM SUBTOTAL					$118,293	$123,227	$241,520	
	Lay down Area								
	Subgrade preparation	10000	SY	1.47		$0	$14,700	$14,700	
	Compact Subgrade	10000	SY	0.78		$0	$7,800	$7,800	
	ITEM SUBTOTAL					$0	$22,500	$22,500	
	ITEM TOTALS					$419,101	$562,730	$981,832	$981,832

Oyster Creek Generating Station

Cooling Tower Study

Construction Cost Estimate Summary

Item No.	DESCRIPTION	QUANTITY	Unit of Measure	Labor Unit Cost ($)	Material / Equipment Unit Cost ($)	Material / Equipment Cost ($)	Total Labor Cost ($)	Total Material Equipment and Labor ($)	Item Total Cost ($)
26	**CONSTRUCTION TRAILERS**								
	ITEM TOTALS	300000				**$300,000**		**$300,000**	**$300,000**
27	**SECURITY FENCE**								
	ITEM TOTALS	4000	LF		$2,325,298	**$2,325,298**	**$4,518,105**	**$6,843,403**	**$6,843,403**
28	**GUARD TOWERS**								
	ITEM TOTALS	3	U		$543,545	**$543,545**	**$1,056,119**	**$1,599,664**	**$1,599,664**
27	**CATHODIC PROTECTION & ILLUM ALLOWANCE**								
	ITEM TOTALS	$1,000,000	LS			**$400,000**	**$600,000**	**$1,000,000**	**$1,000,000**
30	**ANCILLARY BUILDINGS**								
	ITEM TOTALS	$1,000,000	LS $			**$400,000**	**$600,000**	**$1,000,000**	**$1,000,000**
31	**CHLORINATION SYSTEM**								
	ITEM TOTALS	$500,000	LS $			**$200,000**	**$300,000**	**$500,000**	**$500,000**
32	**FIRE PROTECTION SYSTEM**								
	ITEM TOTALS	$3,000,000	LS $			**$1,200,000**	**$1,800,000**	**$3,000,000**	**$3,000,000**
33	**ENGINEERING**								
	ITEM TOTALS	$7,500,000	LS $			**$3,000,000**	**$4,500,000**	**$7,500,000**	**$7,500,000**
34	**GEOTECHNICAL**								
	ITEM TOTALS	$1,500,000	LS $			**$600,000**	**$900,000**	**$1,500,000**	**$1,500,000**
35	**MOBILIZATION**								
	ITEM TOTALS	$2,000,000	LS $			**$2,000,000**		**$2,000,000**	**$2,000,000**
36	**DEMOBILIZATION**								
	ITEM TOTALS	$1,500,000	LS $			**$1,500,000**		**$1,500,000**	**$1,500,000**
37	**QUALITY ASSURANCE**								
	ITEM TOTALS	$1,000,000				**$1,000,000**		**$1,000,000**	**$1,000,000**
38	**CONSTRUCTION MANAGEMENT FEE**								
	ITEM TOTALS	$3,250,000				**$3,250,000**		**$3,250,000**	**$3,250,000**
						Material / Equipment Cost ($)	Total Labor Cost ($)	Total Material Equipment and Labor ($)	Item Total Cost ($)
	DIRECT COST HYBRID COOLING TOWER				$16,718,843	$102,476,161	$141,463,443	$243,939,604	$243,939,604
	Contractors Markup on Bulk Materials	15.0%	Due to scarcity and long term delays of materials from world market.			$15,371,424		$15,371,424	$15,371,424
	Construction labor loss of productivity	25.0%	Assumed 2 hours per day for security entrance and prejob/safety briefings				$35,365,861	$35,365,861	$35,365,861
	New Jersey State Sales Tax	6.0%	On Material, including Contractor Mark-up			$7,070,855		$7,070,855	$7,070,855
	Contingency @ 25 %	25.0%	Degree of confidence on estimate of labor and material			$25,619,040	$35,365,861	$60,984,901	$60,984,901
	TOTAL ESTIMATED COST					$150,537,481	$212,195,165	$362,732,645	**$362,732,645**

Oyster Creek Nuclear Generating Station
Cooling Tower Unavailability Study
10 Year Cost Summary In 2006 Dollars

	Item	Notes	Effective Period	First Year Cost	Labor	Material	Lost Revenue	Added Cost	Total Cost Range	
									Low Risk	High Risk
1	Construction	1,8	initial		$212,195,165	$150,537,481			$362,732,645	$362,732,645
2	Lost Capacity Revenue	3	Life time				$7,086,997		$7,086,997	$7,086,997
3	Lost Energy Revenue	3	Life time				$108,431,185		$108,431,185	$108,431,185
4	Lost Capacity during Outage	9	initial				$4,311,954		$4,311,954	$4,311,954
5	Lost Energy during Outage	9	initial				$80,411,211		$80,411,211	$80,411,211
6	Environmental/Public Relations	4	initial	$1,500,000				$1,500,000	$1,500,000	$1,500,000
7	Added Real Estate Taxes	3	Life time					$47,990,738	$47,990,738	$47,990,738
8	Dislocation of Master Plan	4,8	initial	$500,000				$500,000	$500,000	$500,000
9	Added Security Personnel	3,7	Life time	$1,000,000	$8,659,266				$8,659,266	$8,659,266
10	Added Operators	3,7,10	Life time	$900,000	$7,793,340				$7,793,340	$7,793,340
11	Added Insurance Cost	3,7	Life time	$18,000				$155,867	$155,867	$155,867
12	Maintenance/Chemicals	3,7,8	Life time	$36,000		$311,734		$10,628,580	$10,940,313	$10,940,313
	Subtotal								$640,513,516	$640,513,516
	Risk Factor	5							$64,051,352	$160,128,379
	Total								**$704,564,868**	**$800,641,895**

Risk Factor for NRC, EPA, etc. variances, Natural and Labor risks Low **10.0%** High **25.0%**

NPV of ongoing expenses for 10 years and 7% discount factor with inflation of **3.5%**

OYSTER CREEK NUCLEAR GENERATING STATION

Forked River, NJ

OYSTER CREEK COOLING TOWER ELECTRICAL COST ESTIMATE

				EQUIPMENT		PRIMARY MATERIAL		SUBCONTRACTOR		MATERIAL	LABOR HOURS		LABOR COST Note 2			
	DESCRIPTION	QUANTITY	UNIT	UNIT	TOTAL	UNIT	TOTAL	UNIT	TOTAL	TOTAL	UNIT	TOTAL	RATE	UNIT	TOTAL	TOTAL COST
6																
7	**480 VOLT Switchgear/MCC Enclosure Makeup Supply**															
8	ENCLOSURE - 12 feet by 40 feet	1	EA	$3,600	$3,600	$62,400	$62,400		$0	$66,000	400	400	$125.00	$50,000.00	$50,000	$116,000
9	HIGH VOLTAGE SWITCH	2	EA	$0.00	$0	$14,100	$28,200		$0	$28,200	0	0	$125.00	$0.00	$0	$28,200
10	5000 KVA TRANSFORMERS	2	EA	$0.00	$0	$150,000	$300,000		$0	$300,000	0	0	$125.00	$0.00	$0	$300,000
11	6000 AMPERE MAIN BREAKERS	2	EA	$0.00	$0	$45,000	$90,000		$0	$90,000	0	0	$125.00	$0.00	$0	$90,000
12	4000 AMPERE TIE BREAKER	1	EA	$0.00	$0	$45,000	$45,000		$0	$45,000	0	0	$125.00	$0.00	$0	$45,000
13	6000 A SWITCHGEAR	1	EA	$0.00	$0	$8,000	$8,000		$0	$8,000	0	0	$125.00	$0.00	$0	$8,000
14	SIZE 5 COMBINATION STARTER	36	EA	$0.00	$0	$5,300	$190,800		$0	$190,800	16.00	576	$125.00	$2,000.00	$72,000	$262,800
15	MCC STRUCTURE	5	EA	$0.00	$0	$2,885	$14,425		$0	$14,425	13.33	67	$125.00	$1,666.25	$8,331	$22,756
16	100 A CIRCUIT BREAKER	4	EA	$0.00	$0	$738	$2,952		$0	$2,952	4.00	16	$125.00	$500.00	$2,000	$4,952
17	DISTRIBUTION PANEL, 100 A, 277/480 V	2	EA	$0.00	$0	$760	$1,520		$0	$1,520	15.00	30	$125.00	$1,875.00	$3,750	$5,270
18	DISTRIBUTION PANEL, 100 A, 120/208 V	2	EA	$0.00	$0	$1,275	$7,660		$0	$7,660	13.33	27	$125.00	$1,666.25	$3,333	$10,993
19	75 KVA 480V-120/208 TRANSFORMER	2	EA	$0.00	$0	$4,250	$8,500		$0	$8,500	8.00	0	$125.00	$1,000.00	$0	$8,500
20	CABLE - 500 KCMIL, 3 PH, 600V COPPER, EPR	10800	LF	$0.00	$0	$7.68	$82,944		$0	$82,944	0.120	1296	$125.00	$15.00	$162,000	$244,944
21	EXCAVATION & BACKFILL	10800	LF	$0.11	$1,188	$0	$0		$0	$1,188	0.180	1944	$125.00	$22.50	$243,000	$244,188
22	SITE LIGHTING - 700X1100 FT, 3 FC	1	LOT	$0	$0	$0	$0	$154,000	$154,000	$154,000	0.00	0	$125.00	$0.00	$0	$154,000
23	Sub total Labor and Material									$1,001,189					$544,414	$1,545,603
24	**480 VOLT Switchgear/MCC Enclosure Makeup Supply**															
25	ENCLOSURE - 8 feet by 10 feet	1	EA	$3,600	$3,600	$10,400	$10,400		$0	$14,000	200.0	200	$125.00	$25,000.00	$25,000	$39,000
26	HIGH VOLTAGE SWITCH	2	EA	$0.00	$0	$14,100	$28,200		$0	$28,200	0.0	0	$125.00	$0.00	$0	$28,200
27	1000 KVA TRANSFORMERS	2	EA	$0.00	$0	$58,588	$117,176		$0	$117,176	0.0	0	$125.00	$0.00	$0	$117,176
28	1600 AMPERE MAIN BREAKERS	2	EA	$0.00	$0	$14,205	$28,410		$0	$28,410	0.0	0	$125.00	$0.00	$0	$28,410
29	1600 AMPERE TIE BREAKER	1	EA	$0.00	$0	$14,205	$14,205		$0	$14,205	0.0	0	$125.00	$0.00	$0	$14,205
30	2000 A SWITCHGEAR	1	EA	$0.00	$0	$3,325	$3,325		$0	$3,325	0.0	0	$125.00	$0.00	$0	$3,325
31	SIZE 6 COMBINATION STARTER	2	EA	$0.00	$0	$10,900	$21,800		$0	$21,800	20.0	40	$125.00	$2,500.00	$5,000	$26,800
32	SIZE 8 COMBINATION STARTER	1	EA	$0.00	$0	$50,000	$50,000		$0	$50,000	30.0	30	$125.00	$3,750.00	$3,750	$53,750
33	MCC STRUCTURE	1	EA	$0.00	$0	$2,885	$2,885		$0	$2,885	13.33	13	$125.00	$1,666.25	$1,666	$4,551
34	CABLE - 500 KCMIL, 3 PH, 600V COPPER, EPR	300	LF	$0.00	$0	$7.68	$2,304		$0	$2,304	0.120	36	$125.00	$15.00	$4,500	$6,804
35	EXCAVATION & BACKFILL	300	LF	$0.11	$33	$0.00	$0		$0	$33	0.180	54	$125.00	$22.50	$6,750	$6,783
36	Sub total Labor and Material									$282,338					$46,666	$329,004
37	**34.5 KV Substation**															
38	TRANSFORMER 20 MVA 34.5 KV-4.16 KV	2	EA	$3,616	$7,232	$300,000	$600,000		$0	$607,232	272.32	545	$125.00	$34,040.00	$68,080	$675,312
39	FOUNDATION & AUX EQUIPMENT	50	CY	$127.05	$6,353	$91	$4,525		$0	$10,878	7.498	375	$125.00	$937.25	$46,863	$57,740
40	PROTECTIVE RELAYING EQUIPMENT	1	LOT	$0	$0	$30,000	$30,000		$0	$30,000	160	160	$125.00	$20,000.00	$20,000	$50,000
41	RTU	1	EA	$0	$0	$15,000	$15,000		$0	$15,000	80	80	$125.00	$10,000	$10,000	$25,000
42	GRADING,SITEWORK, GROUNDING, FENCING	1	LOT	$0	$0	$0	$0	$30,000	$30,000	$30,000	0.00	0	$125.00	$0.00	$0	$30,000
43	38 KV SWITCHGEAR, IN SWITCHGEAR ENCLOSURE - 2 TRANSFORMER BREAKERS, ONE TIE BREAKER, 2 FEEDER BREAKERS	1	EA	$3,600	$3,600	$450,000	$450,000		$0	$453,600	400.0	400	$125.00	$50,000.00	$50,000	$503,600
44	34.5 KV CABLE FROM TRANSFORMER TO SWGR, 1-500 kcmil	80	LF	$0.00	$0	$30	$2,400		$0	$2,400	0.2	19	$125.00	$30.00	$2,400	$4,800
45	TERMINATION, 1 PHASE	12	EA	$0.00	$0	$222	$2,664		$0	$2,664	1.333	78	$125.00	$166.63	$9,688	$12,352
46	CONDUIT, 4 IN	80	LM	$0.00	$0	$28	$2,240		$0	$2,240	0.400	32	$125.00	$50.00	$4,000	$6,240
47	34.5 KV CABLE FROM MAIN SUBSTATION TO SWGR, 1-500 kcmil	2800	LF	$0.00	$0	$30	$84,000		$0	$84,000	0.240	672	$125.00	$30.00	$84,000	$168,000
48	EXCAVATION & BACKFILL	1400	LF	$0.11	$154	$0	$0		$0	$154	0.180	252	$125.00	$22.50	$31,500	$31,654
49										$1,238,168					$326,530	$1,564,698

OYSTER CREEK NUCLEAR GENERATING STATION
Forked River, NJ
OYSTER CREEK COOLING TOWER ELECTRICAL COST ESTIMATE

				EQUIPMENT		PRIMARY MATERIAL		SUBCONTRACTOR		MATERIAL	LABOR HOURS		LABOR COST Note 2			
	DESCRIPTION	QUANTITY	UNIT	UNIT	TOTAL	UNIT	TOTAL	UNIT	TOTAL	TOTAL	UNIT	TOTAL	RATE	UNIT	TOTAL	TOTAL COST
50	**5 KV Switchgear/MCC Enclosure**															
51	ENCLOSURE - 12 feet by 40 feet	1	EA	$3,600	$3,600	$62,400	$62,400		$0	$66,000	400	400	$125.00	$50,000.00	$50,000	$116,000
52	HIGH VOLTAGE SWITCH	2	EA	$0.00	$0	$11,200	$22,400		$0	$22,400	0.0	0	$125.00	$0.00	$0	$22,400
53	1200 AMPERE MAIN BREAKERS	2	EA	$0.00	$0	$30,000	$60,000		$0	$60,000	0.0	0	$125.00	$0.00	$0	$60,000
54	1200 AMPERE TIE BREAKER	1	EA	$0.00	$0	$30,000	$30,000		$0	$30,000	0.0	0	$125.00	$0.00	$0	$30,000
55	2000 A SWITCHGEAR	1	EA	$0.00	$0	$6,650	$6,650		$0	$6,650	0.0	0	$125.00	$0.00	$0	$6,650
56	600 A BREAKERS	12	EA	$0.00	$0	$30,000	$360,000		$0	$360,000	0.0	0	$125.00	$0.00	$0	$360,000
57	MOTOR STARTER FOR 1500 HP MOTOR	4	EA	$0.00	$0	$40,855	$163,420		$0	$163,420	0.0	0	$125.00	$0.00	$0	$163,420
58	MOTOR STARTER FOR 2500 HP MOTOR	4	EA	$0.00	$0	$49,418	$197,672		$0	$197,672	0.0	0	$125.00	$0.00	$0	$197,672
59																
60	CABLE - 500 KCMIL, 3 PH, 5KV COPPER, EPR	7200	LF	$0.00	$0	$20.25	$145,800		$0	$145,800	0.200	1441	$125.00	$25.01	$180,090	$325,890
61	SPLICE, 1 PHASE - 500 KCMIL	84	EA	$0.00	$0	$295	$24,780		$0	$24,780	4.211	354	$125.00	$526.38	$44,216	$68,996
62	TERMINATION, 1 PHASE - 500 KCMIL	54	EA	$0.00	$0	$222	$11,988		$0	$11,988	1.333	72	$125.00	$166.63	$8,998	$20,986
63	EXCAVATION & BACKFILL	7200	LF	$0.11	$792	$0.00	$0		$0	$792	0.180	1296	$125.00	$22.50	$162,000	$162,792
64										$1,089,502					$445,303	$1,534,805
65	**Relocation of Overhead 34.5 KV Lines**		1600 feet													
66	CABLE - 500 KCMIL, 3 PH, 35KV COPPER, EPR	3200	LF	$0.00	$0	$30.00	$96,000		$0	$96,000	0.240	768	$125.00	$30.00	$96,000	$192,000
67	SPLICE, 1 PHASE - 500 KCMIL	12	EA	$0.00	$0	$295	$3,540		$0	$3,540	4.211	51	$125.00	$526.38	$6,317	$9,857
68	TERMINATION, 1 PHASE - 500 KCMIL	12	EA	$0.00	$0	$222	$2,664		$0	$2,664	1.3330	16	$125.00	$166.63	$2,000	$4,664
69	EXCAVATION & BACKFILL	3200	LF	$0.11	$352	$0.00	$0		$0	$352	0.018	58	$125.00	$2.25	$7,200	$7,552
70																
71	CABLE - 500 KCMIL, 3 PH, 15KV COPPER, EPR	1600	LF	$0.00	$0	$21.90	$35,040		$0	$35,040	0.2400	384	$125.00	$30.00	$48,000	$83,040
72	SPLICE, 1 PHASE - 500 KCMIL	6	EA	$0.00	$0	$295	$1,770		$0	$1,770	4.2110	25	$125.00	$526.38	$3,158	$4,928
73	TERMINATION, 1 PHASE - 500 KCMIL	6	EA	$0.00	$0	$222	$1,332		$0	$1,332	1.3330	8	$125.00	$166.63	$1,000	$2,332
74	EXCAVATION & BACKFILL	1600	LF	$0.11	$176	$0.00	$0		$0	$176	0.180	288	$125.00	$22.50	$36,000	$36,176
75																
76	REMOVAL OF OVERHEAD WIRE & POLES	4800	LF	$0.11	$528	$0.00	$0		$0	$528	1.00	4800	$125.00	$125.00	$600,000	$600,528
77										$141,402					$799,674	$941,076
78	**TOTALS (Material and Labor)**	1	EA		$31,208		$3,537,391		$184,000	$3,752,599		17301			$2,162,587	$5,915,186

COST SUMMARY				
Material			$3,752,599	
Labor			$2,162,587	
Sub total Labor and Material			$5,915,186	
Expenses	2%		$118,304	
Tools/Materials Handling	1%		$59,152	
Overhead	6%		$354,911	
Sub Total			$6,447,552	
Profit	3%		$193,427	
Bonding	2%		$128,951	
Risk	2%		$128,951	
Sub Contractor Total			$6,898,881	$6,898,881
Design Contingency	35%		$2,414,608	
Construction Contingency	10%		$689,888	
Design and Construction Management	12%		$827,866	$827,866
Total			$10,831,200	$7,726,747 DH

Oyster Creek Nuclear Generating Station
Forked River, NJ
Summary of Reduction of Net Power

	Item	Units	Notes	Winter	Spring	Summer	Fall	Winter Capacity	Summer Capacity
5	**Ambient conditions**								
6	Ambient Dry Bulb	°F	1	36.0	50.0	72.1	57.7	20.0	87.0
7	Ambient Wet bulb	°F	1	31.4	44.2	62.0	49.8	17.1	77.0
8									
9	**LP STG output with once through cooling**								
10	Inlet cooling water temperature	°F	2,9	39.9	55.0	79.0	62.0	34.9	83.7
11	Exhaust Back Pressure	In Hg A	9	0.928	1.163	2.295	1.421	0.805	2.615
12	Net LP Steam Turbine Output	kW	3	404,837	404,954	387,683	403,321	404,710	380,065
13	Circulating Water Pump Load	kW	4	2,663	3,551	3,551	3,551	2,663	3,551
14	Dilution Pump Load	kW	4	2,676	2,676	2,676	2,676	2,676	2,676
15	Net Plant output	kW		**399,498**	**398,727**	**381,456**	**397,094**	**399,371**	**373,838**
16									
17	**LP STG output with hybrid cooling towers**								
18	Mode of Operation			Wet -Dry	Wet -Dry	Wet	Wet -Dry	Wet -Dry	Wet
19	Inlet cooling water temperature	°F	9	77.2	82.8	76.9	85.5	70.7	86.1
20	Exhaust Back Pressure	In Hg A	9	2.185	2.555	2.162	2.747	1.819	2.793
21	Net LP Steam Turbine Output	kW	3	390,161	381,722	390,708	377,137	397,733	376,061
22	Cooling Tower Fan Load	kW		6,823	6,840	6,398	6,837	6,785	6,391
23	Circulating Water Lift Pump	kW	5	8,955	8,955	8,955	8,955	8,955	8,955
24	Circulating Water Pump Load	kW	6	5,970	5,970	5,970	5,970	5,970	5,970
25	Dilution Pump Load	kW	8	1,338	1,338	1,338	1,338	1,338	1,338
26	Make-up Water Pump		7	204	234	252	322	169	346
27	Net Plant output	kW		**366,872**	**358,385**	**367,795**	**353,715**	**374,516**	**353,061**
28	**Net loss in output**	kW		**32,626**	**40,342**	**13,661**	**43,379**	**24,854**	**20,777**

1 Cooling Tower Lift Head 75 feet
2 Circulation Pump head 50 feet
3 Make-up Water Pump head 100 feet

Oyster Creek Nuclear Generating Station
Forked River, NJ
Oyster Creek Price Assumptions Used in LRP II Pass for Levelized Present Worth

ATC Energy Price	Winter (D, J, F)		Spring (M, A, M)		Summer (J, J, A)		Fall (S, O, N)		Average Energy Pricing	ICAP $/mw day	Year	Present Worth Factor	Energy Present Value	Capacity Present Value
	$/MW/hr		$/MW/hr		$/MW/hr		$/MW/hr		$/MW/hr		N =	I =	$/MWh	$/MWDay
Year	Days 90		Days 92		Days 92		Days 91		365			7.00%		
2006	$57.609	57.609	$43.413	43.413	$46.283	46.283	$57.609	57.609	$51.176	$11.271	0	1.0000	51.176	11.271
2007	$54.225	50.677	$40.080	37.458	$42.961	40.150	$31.012	28.983	$42.033	$24.896	1	0.9346	39.283	23.267
2008	$51.994	45.413	$39.242	34.275	$40.293	35.193	$29.969	26.176	$40.339	$54.000	2	0.8734	35.234	47.166
2009	$53.175	43.406	$39.751	32.449	$39.184	31.986	$31.722	25.894	$40.916	$79.000	3	0.8163	33.400	64.488
2010	$52.071	39.725	$38.388	29.286	$37.384	28.520	$30.686	23.410	$39.589	$91.815	4	0.7629	30.202	70.045
2011	$51.494	36.714	$38.702	27.594	$37.953	27.060	$32.125	22.905	$40.028	$91.337	5	0.7130	28.539	65.122
2012	$51.966	34.627	$40.066	26.697	$38.131	25.408	$34.302	22.857	$41.075	$104.403	6	0.6663	27.370	69.568
2013	$52.944	32.971	$41.675	25.953	$39.787	24.777	$35.565	22.148	$42.454	$122.388	7	0.6227	26.438	76.217
2014	$54.939	31.975	$43.501	25.318	$41.991	24.439	$38.355	22.323	$44.658	$135.280	8	0.5820	25.991	78.734
2015	$55.323	30.092	$44.676	24.301	$44.680	24.303	$40.680	22.127	$46.306	$154.051	9	0.5439	25.187	83.793
2016	$54.590	27.751	$44.761	22.754	$41.891	21.295	$39.545	20.103	$45.161	$153.372	10	0.5083	22.958	77.967
Sum		373.352		286.085		283.133		236.926			Sum	7.0236	$294.60	$656.367
Seasonal Levelized		$53.157		$40.732		$40.312		$33.733	$41.945	Levelized			$41.945	$93.452

Lost Generation with Hybrid Cooling towers

	kW	32,626	kW	40,342	kW	13,661	kW	43,379	PJM Summer Capacity reduction	20,777	kW
	MWH	70,472	MWH	89,075	MWH	30,162	MWH	94,739	10 yr levelized capacity revenue loss	$7,086,997	
Annually	$3,746,088		$3,628,192		$1,215,901		$3,195,817		Levelized energy revenue loss	$10,843,118	
10 Years	$37,460,879		$36,281,920		$12,159,013		$31,958,172		10 yr levelized energy revenue loss	$108,431,185	

Lost revenue during construction					
Construction timing				150	
Coincidental refueling				21	
Net Loss due to Cooling tower construction				129	*Fall 08-Wint'09*
	Power	Days	Hours	$/unit	
Lost energy - Fall	640,000	70	1680	$29.969	$32,222,237
Lost energy - Winter	640,000	59	1416	$53.175	$48,188,974
					$80,411,211
Lost Capacity	619,000	129		$54.000	$4,311,954

Oyster Creek Annual Capacity Factor Goal **92.0%**

OYSTER CREEK NUCLEAR GENERATING STATION
Forked River, NJ
Added Real Estate Taxes due to Cooling Tower

Year	Estimated Cost Ratio	Estimated Tax Rate	Taxes	
2001	90.19%	2.27%	$1,303,978	This Projection is based on an estimated projected 2008 ratio of 32.37%.
2002	83.77%	2.48%	$1,421,530	
2003	75.11%	2.72%	$1,557,433	
2004	64.82%	2.87%	$1,644,594	
2005	55.82%	2.98%	$1,706,524	
2006	41.79%	3.18%	$1,825,713	Cooling Tower contribution
2007	36.78%	3.41%	$1,953,228	
2008	32.37%	3.64%	$5,565,667	$3,476,019
2009	28.49%	3.90%	$5,954,392	$3,718,797
2010	25.07%	4.17%	$6,370,268	$3,978,530
2011	22.07%	4.46%	$6,815,189	$4,256,404
2012	19.42%	4.77%	$7,291,185	$4,553,686
2013	17.09%	5.11%	$7,800,426	$4,871,731
2014	15.04%	5.46%	$8,345,235	$5,211,989
2015	13.24%	5.85%	$8,928,095	$5,576,013
2016	11.65%	6.25%	$9,551,663	$5,965,460
2017	10.25%	6.69%	$10,218,784	$6,382,109
2018	9.02%	7.16%	$10,932,499	$6,827,857
2019	7.94%	7.66%	$11,696,062	$7,304,738
2020	6.99%	8.19%	$12,512,955	$7,814,926
			Total Tax Dollars	**$47,990,738**

Project Cost	**$294,676,889**
2008 Projected ratio	**32.37%**

Oyster Creek Nuclear Generating Station
Forked River, NJ
Calculation for Added Security Fence & Towers

4	**Basis of "All Inclusive 2004 Security Improvements"**				
5	**Description**	**Cost**	**# of Units**	**Unit Rate**	
6	Delay Fence	$ 7,087,567.88	6655	$ 1,065.00	linear foot
7	Inner Vehicle Barrier	$ 1,106,033.60	3504	$ 315.65	linear foot
8	BRE	$ 3,012,148.60	7	$ 430,306.94	BRE
9	Engineering	$ 2,698,539.57		$ 0.13	% of DBT Cost
10	**Stated Assumptions for added security improvements**				
11	1400 pipe run to CT along intake embankment				
12	500 length of 1st CT				
13	500 length of 2nd CT				
14	100 distance between CT				
15	100 Set backs				
16	1400 completing SPA loop				
17	**4000** feet				
18					
19	1) Installation of Cooling Towers results in ~4000' expansion of SPA				
20	2) SPA expansion requires 3 BRE Towers				
21	**Pricing for Added Security for Cooling Tower additions**				
22	Fence	4000	$ 1,380.65	$5,522,591	
23	Towers	3	$ 430,306.94	$1,290,921	
24			Sub Total	$6,813,512	
25			Engineering	$862,003	
26			2004 dollars	**$7,675,515**	
27	Assumed inflation and cost increases from 2004 to 2006			10.0%	
28			Total	**$8,443,067**	
29	**Prorated 2006 Cost**				
30			Prorated Fence	Prorated Tower	
31	Admin costs	4.2%	$288,149.3	$67,355.7	
32	Material	29.8%	$2,037,148.7	$476,189.1	
33	Labor	66.0%	$4,518,104.7	$1,056,119.4	
34		Total Cost	**$6,843,403**	**$1,599,664**	**$8,443,067**
35		Units	4,000	3	
36		Unit Cost	$1,711	$533,221	

APPENDIX C
COST-COST ANALYSIS

Appendix C

Cost-Cost Analysis for the Conceptual Hybrid Cooling Tower System at the Oyster Creek Generating Station

The cost of compliance with the Phase II Section 316(b) Rule should not be significantly greater than the costs considered by USEPA in adopting the Rule. A cost-cost test is used to make this determination following the steps presented in the Rule at §125.94(a)(5)(i). The Rule cost-cost methodology is:

> "(A) Determine which technology the Administrator modeled as the most appropriate compliance technology for your facility;
> (B) Using the Administrator's costing equations, calculate the annualized capital and net operation and maintenance (O&M) costs for a facility with your design intake flow using this technology;
> (C) Determine the annualized net revenue loss associated with net construction downtime that the
> Administrator modeled for your facility to install this technology;
> (D) Determine the annualized pilot study costs that the Administrator modeled for your facility to test and optimize this technology;
> (E) Sum the cost items in paragraphs (a)(5)(i)(B), (C), and (D) of this section; and
> (F) Determine if the performance standards that form the basis of these estimates (*i.e.*, impingement mortality reduction only or impingement mortality and entrainment reduction) are applicable to your facility, and if necessary, adjust the estimates to correspond to the applicable performance standards."

To perform a cost-cost analysis of installing the hybrid cooling conceptual model at OCGS, this methodology was applied as follows:

- Step 1: Determine which technology USEPA modeled as the most appropriate compliance technology for OCGS (EPA Facility ID DUT1023).

- Step 2: Using USEPA's costing equations, calculate the annualized capital and net O&M costs for OCGS adjusted for the actual facility design intake flow and their technology.

- Step 3: Determine the annualized net revenue loss associated with net construction downtime that USEPA modeled for OCGS to install the technology and the annualized pilot study costs that USEPA modeled for OCGS to test and optimize the technology.

- Step 4: Add the flow adjusted annualized capital and O&M costs, and the annualized facility downtime and pilot study costs, to get the preliminary costs considered by USEPA for OCGS.

- Step 5: Determine which performance standards in §125.94(b)(1) and (2) (i.e., impingement mortality only, or impingement mortality and entrainment) are applicable to OCGS, and compare these to the performance standards on which USEPA's cost estimates are based.

USEPA modeled a new, larger intake with fine-mesh and fish handling and return system in front of the existing intake system as the most appropriate compliance technology for OCGS. Calculations following Steps 2, 3, and 4 were completed to determine the preliminary costs considered by the USEPA applicable for OCGS.

USEPA assumed a design intake flow rate of 998,444 gpm, total for both the cooling water intake structure and the dilution water intake structure. The calculation flow rate was adjusted for design maximum water withdrawal rate at the OCGS (1,240,000 gpm or 1785.6 MGD). Since the performance requirements for impingement mortality and entrainment for OCGS are the same as those assumed by USEPA, the preliminary costs calculated in Step 4 did not have to be adjusted further.

Based on the cost-cost test, the costs considered by USEPA for OCGS are approximately $11.2 million per year for ten years (see the calculation sheets that follow). This equates to a Net Present Value (NPV) cost of approximately $78.7 million for the addition of a new, larger intake with fine-mesh and fish handling and return system (assuming a 7% discount rate over the 10-year period).

In summary, the adjusted NPV cost of 316(b) compliance estimated by USEPA is $78.7 million. The estimated costs for cooling towers at OCGS, $704.6 million to $800.6 million (see Appendix B), are significantly greater than the USEPA costs.

Oyster Creek Cost-Cost Study
Cooling Water Intake Structure

The information for Oyster Creek is included in Appendix A of the final rule. Note that the EPA lists the Cooling Water and Dilution Water intake structures separately. Each intake structure must stand on it's own merit for the Cost-Cost Study. The EPA considers both to be I&E sites.

Step 1: Determine appropriate EPA modeled technology:

This information is given in column 12 of Appendix A of the regulations.

First, identify the EPA Facility ID as listed in Appendix B of the regulations

EPA Facility ID: DUT1023

The appropriate EPA modeled technology code is:

3 - Addition of a new, larger intake with fine-mesh and fish handling and return system in front of an existing intake system.

Step 2: EPA's Costing Equations:

$$Y_f = y_{epa} + m*(x_f - x_{epa})$$

Y_f = Annualized capital and net O&M costs using the actual facility design intake flow
x_f = Actual facility design intake flow (gallons per minute)
x_{epa} = EPA assumed facility design intake flow (gallons per minute, from column 3)
y_{epa} = Annualized capital and net O&M costs using EPA design intake flows (from column 7)
m = Design flow adjustment slope (from column 13)

x_f =	460,000 gpm (design capacity)	662.4 MGD
x_{epa} =	478,444 gpm	689.0 MGD
y_{epa} =	$ 4,037,344	
m =	3.4562	

Y_f = **$ 3,973,598**

Step 3: Annualized Net Revenue Loss Associated with Construction & Pilot Studies.

This data is given in column 10 of Appendix A.

Net revenue loss & pilot study costs: $ -

Step 4: Preliminary Costs Considered by EPA (Sum of Steps 2 & 3)

Preliminary Costs = $ 3,973,598

Step 5: Determination of performance standards:

Oyster Creek CWS #535 is subject to meeting Impingement & Entrainment standards. The EPA's estimates are based meeting Impingement & Entrainment standards.

Multiply Preliminary costs by: 1 (No adjustment is required)

Preliminary Costs = $ 3,973,598

Conclusion:

The costs that are considered by the EPA are: $ 3,973,598 per year for a 10 year period.

If a facility can demonstrate that the actual compliance costs are 'significantly greater' than those considered by EPA, the director must make a site-specific determination of the best technology available for minimizing adverse environmental impacts.

Oyster Creek Cost-Cost Study
Dilution Water Intake Structure

The information for Oyster Creek is included in Appendix A of the final rule. Note that the EPA lists the Cooling Water and Dilution Water intake structures separately. Each intake structure must stand on it's own merit for the Cost-Cost Study. The EPA considers both to be I&E sites.

Step 1: Determine appropriate EPA modeled technology:

This information is given in column 12 of Appendix A of the regulations.

First, identify the EPA Facility ID as listed in Appendix B of the regulations

EPA Facility ID: **DUT1023**

The appropriate EPA modeled technology code is:

3 - Addition of a new, larger intake with fine-mesh and fish handling and return system in front of an existing intake system.

Step 2: EPA's Costing Equations:

$$Y_f = y_{epa} + m * (x_f - x_{epa})$$

Y_f = Annualized capital and net O&M costs using the actual facility design intake flow

x_f = Actual facility design intake flow (gallons per minute)

x_{epa} = EPA assumed facility design intake flow (gallons per minute, from column 3)

y_{epa} = Annualized capital and net O&M costs using EPA design intake flows (from column 7)

m = Design flow adjustment slope (from column 13)

x_f =	780,000 gpm (design capacity)	1,123 MGD
x_{epa} =	520,000 gpm	748.8 MGD
y_{epa} =	$ 5,917,486	
m =	3.4562	

Y_f = **$ 6,816,098**

Step 3: Annualized Net Revenue Loss Associated with Construction & Pilot Studies.

This data is given in column 10 of Appendix A.

Net revenue loss & pilot study costs: $ 389,267

Step 4: Preliminary Costs Considered by EPA (Sum of Steps 2 & 3)

Preliminary Costs = $ 7,205,365

Step 5: Determination of performance standards:

Oyster Creek DWS #536 is subject to meeting Impingement & Entrainment standards. The EPA's estimates are based meeting Impingement & Entrainment standards.

Multiply Preliminary costs by: 1 (No adjustment is required)

Preliminary Costs = $ 7,205,365

Conclusion:

The costs that are considered by the EPA are: $ 7,205,365 per year for a 10 year period.

If a facility can demonstrate that the actual compliance costs are 'significantly greater' than those considered by EPA, the director must make a site-specific determination of the best technology available for minimizing adverse environmental impacts.

Attachment 2

Answers to Requests (3) and (4)

Background

RAIs 3 and 4 relate to normal operation and construction of a closed-cycle cooling tower system. In accordance with the NRC Request for Additional Information, the closed-cycle cooling system is evaluated as an alternative to the proposed action to operate the current once-through cooling system. (NRC 2005)

AmerGen examined each of the 91 issues in Table B-1 of the Nuclear Regulatory Commission's Appendix B to Subpart A – Environmental Effect of Renewing the Operating License of a Nuclear Plant (10 CFR 51). The general categories in Table B-1 that do not apply to construction or normal operation of a cooling tower system (e.g., Postulated Accidents) were not included in the analysis. Conversely, AmerGen assessed the environmental impacts of each applicable issue in the remaining general categories as they relate to construction and operation of a cooling tower system at Oyster Creek Generating Station (OCGS), regardless of whether they were considered impacts of cooling towers in Table B-1.

For example, the GEIS (NRC 1996) evaluated Issue 3, Altered Current Patterns, relevant to the increased flow of a once-through system over the ambient flow in the receiving water body. However, replacing a once-through system with cooling towers, a scenario not considered in the GEIS, could alter (decrease flow) current patterns in the receiving water body, so this analysis was done and the results included in Table 3-1. Other issues that fall into this category are Issue 4, Altered Salinity, and Air Quality during operations.

1.0 Description of Cooling Tower Designs Considered

For the purposes of assessment, AmerGen conducted a study of alternative cooling tower types and prepared a conceptual design of the preferred system. AmerGen evaluated the following six types of cooling towers: natural draft; linear mechanical draft; round mechanical draft; dry air-cooled; linear hybrid; and round hybrid. A hybrid system is a combination of a wet evaporative cooling system and a dry cooling system. Details on these cooling-water systems and the selection of the hybrid system are provided in *Determination of Cooling Tower Availability for Oyster Creek Generating Station, Forked River, New Jersey* (AmerGen 2006) that is included as part of the Response to the NRC Request for Additional Information (NRC 2005).

<u>Natural draft</u> - The natural draft cooling tower was eliminated from consideration mainly because of the significantly higher price, problems with constructability of this type of tower in the United States, permitting problems (local zoning and permitting issues), and public perception of its adverse visual impact.

<u>Linear mechanical draft</u> - This system was the primary unit under consideration because it is the most common closed system used for power plant heat rejection and, therefore, has the lowest base price compared to the other types of towers. The plume produced by a linear mechanical draft tower would not meet current security requirements, which require an unimpeded view at ground level. Thus, this option was eliminated because of security restrictions on ground fogging.

Round mechanical draft - The round mechanical draft cooling tower has an installed pricing of approximately two times the cost of a linear mechanical draft evaporative cooling tower. A round mechanical draft tower presents a concentrated center plume that provides buoyancy to elevate the plume higher than a linear mechanical draft evaporative tower but not as high as the natural draft tower. The elevated plume reduces ground fog/icing compared to the linear tower. Although there is a reduction compared to the linear tower, the plume produced by a round mechanical draft tower would not meet current security requirements, which require an unimpeded view at ground level. Thus, this option was eliminated because of ground fogging and cost.

Dry air-cooled - While a tower with a dry air-cooled condenser system would eliminate a visible vapor plume (fog) this type of tower covers an extremely large land area and would require a total revamping of the turbine exhaust system with the complete removal and redesign of the shell and tube condenser. The cost of the air-cooled condenser is approximately six times the base tower cost, and this type of tower is the noisiest of all the options considered. This option was eliminated because of the large land area required, the technical obstacles of the conversion, noise, and the extremely high price.

Linear (and Round) wet/dry hybrid - A hybrid design can control or eliminate ground fog. The wet evaporative section of the hybrid tower is essentially the same design as the "base" mechanical draft evaporative cooling tower. A dry section is added to the top of the main tower. During seasons when fogging is least likely to occur (spring, summer, and fall) the tower operates as a conventional mechanical draft evaporative cooling tower. During time periods when fogging is likely to occur (winter) the tower is operated in a combined mode with the dry section adding heat to the exhaust plume to dissipate the visible fog. A hybrid design can control or eliminate ground fog. The pricing of the linear hybrid tower ranges from two to three times the cost of a linear mechanical draft evaporative cooling tower. A hybrid system tower was chosen as the optimal cooling tower type for OCGS because of its effectiveness in reducing a visible plume.

Design Selected

AmerGen selected a hybrid system (combination of wet evaporative cooling and dry cooling) because of the need for both consumptive water use reduction and plume abatement. Table 1-1 presents engineering parameters of the selected system.

Table 1-1. Engineering Parameters of the Hybrid Cooling Tower System[1]

Recirculating closed-cycle hybrid cooling system with two multi-cell mechanical hybrid fiberglass cooling towers arranged in two rows
14,000 gpm makeup
7,000 gpm evaporation
7,000 gpm blowdown
460,000 gpm circulating flow
Drift 0.0005% of circulating flow
2 cycles of concentration

[1] Full evaporative cooling mode (summer)

The selected conceptual model is a recirculating closed-cycle wet/dry hybrid cooling system with two multi-cell mechanical hybrid fiberglass cooling towers arranged in two rows. The towers would be located adjacent to the existing plant west of Route 9, would be 80 feet high, and would operate at two cycles of concentration (see Figure 4 in AmerGen 2006). There would be two pump houses associated with this installation. One existing dilution pump would continue to operate.

2.0 Description of New Cooling System and Changes to Existing System

Hot water from the circulating water discharge flume would be diverted to the proposed mechanical draft cooling tower by means of a 12-foot diameter pre-stressed concrete cylinder pipe (PCCP) running from the flume to the cooling tower lift pumping station. After passing through the cooling tower, cold water would be returned to the existing circulating water supply flume.

The following modifications, structures and equipment would be required:

- Interconnections between existing circulating water supply and discharge flumes and new circulating water conduits
- Two below-grade 12-foot diameter PCCP conduits to convey circulating water to and from the cooling towers
- Two pumping stations
- Two cooling towers
- Two cooling tower basins
- Cooling tower makeup and blowdown systems
- Relining existing flumes
- Condenser water box replacement

2.1 INTERCONNECTIONS BETWEEN EXISTING CIRCULATING WATER SUPPLY AND DISCHARGE FLUMES WITH THE NEW CIRCULATING WATER CONDUITS

The existing cooling water supply and discharge flumes would be connected with the new circulating water conduits by transition chambers. The internal dimension of the chambers would be 17-feet high by 17-feet wide by 20-feet long. The chambers would be constructed using reinforced concrete and founded on piles to avoid settlement and joint failures.

2.2 TWO BELOW GRADE 12-FOOT DIAMETER PCCP CONDUITS TO CONVEY CIRCULATING WATER TO AND FROM THE COOLING TOWERS

Cooling water would be transferred from the existing cooling water system flumes to the cooling towers by means of 1,600 feet of 12-foot diameter PCCP placed underground and supported on piles. Due to numerous utility interferences the initial 500 feet of the pipeline would be installed in a deep trench. The invert of the pipelines would rise from -40 feet mean sea level (msl) at the location of the transfer structure to approximately -6 feet msl in the area where an existing water storage tank is located. Grade is 20 feet msl so -40 msl is 60 feet below grade and -6 msl is 26

feet below grade. The depth of the trench would require continuous dewatering during construction.

The subsequent 1,100 feet of PCCP would require a trapezoidal trench to zero msl (20 feet below grade) and backfilling the pipelines. The pipeline trenches would also be used to install the 30-inch-diameter makeup water pipeline and some of the electrical conduits.

2.3 TWO NEW PUMPING STATIONS

Two new circulating water pump houses would be required. One of the pump houses would pump the circulating water from the condenser into the cooling tower. The other would pump the water from the cooling tower basin back to the condenser. Each pump house would have four circulating water pumps. Each pump would be rated at 115,000 gpm.

2.4 MECHANICAL DRAFT COOLING TOWERS

The mechanical-draft cooling tower assembly would consist of two cooling tower units each consisting of 18 back-to-back cooling tower cells installed in two rows constructed of fiberglass with polyvinyl chloride fill. The total cooling tower design flow is 460,000 gpm (12,800 gpm per cell).

Thirty-six-inch diameter steel pipe risers distribute circulating water flow into each of the cooling tower cells. The diameter of the underground manifold varies between 144-inch (12-foot) and 96-inch (8-foot). A cold weather bypass would provide freeze protection during the winter months.

2.5 COOLING TOWER BASINS

Two rectangular cooling tower basins (120 feet wide, 500 feet long and 6 feet deep) would be constructed of reinforced concrete and supported by a piling foundation consisting of 600 piles per basin.

2.6 COOLING TOWER MAKEUP AND BLOWDOWN SYSTEMS

Makeup water would be pumped from the intake canal into the cooling tower basins by three 50-percent capacity pumps rated at 10,000 gpm each. A fourth pump would provide emergency backup pumping capability.

Blowdown would be piped to the existing dilution pump structure and from there discharged to Oyster Creek through two of the three existing dilution pump discharges. One dilution pump would continue to pump Forked River water that would dilute the blowdown.

2.7 RELINING OF EXISTING COOLING WATER SYSTEM FLUMES

The existing flumes that interconnect the circulating water pump house with the condenser and, in turn, the condenser with the circulating water system discharge structure are not designed to sustain the operating and transient pressures imposed by the addition of the cooling towers. Consequently, the existing flumes must be structurally reinforced. The structural reinforcement would be ¾-inch steel plates lining the flume walls. A steel liner would maintain the available flow area close to the existing cross sectional area.

2.8 CONDENSER WATER BOX REPLACEMENT

The new 12-foot diameter pipe that would be interconnected to the existing cooling water supply flume would convey water from the cooling tower basin to the intake of the condenser where it would be distributed to the condenser inlet water boxes. After passing through the condenser tubes, heated water would enter the outlet water boxes, be piped to the existing discharge flume and then back to the cooling tower through the new 12-foot diameter return pipe.

The existing water boxes would need to be replaced with new water boxes with a pressure rating capable of withstanding the increased pressure of the circulating water at the condensers. Each of the water boxes is approximately 11½ feet high, 8 feet wide and over 9 feet deep.

2.9 EFFECTS ON LAND AND AIR

2.9.1 Land Disturbed

Approximately 13.5 acres would be involved in construction. Of those, 10 would be permanently converted to structures or impervious surfaces. Existing land cover includes grasses, shrubs, and several mature trees.

- Roadway inside/outside security fence = 2.4 acres
- Cooling tower basins = 3.0 acres
- Pump houses = 0.5 acres
- Impervious area around structures = 2.75 acres
- Filters = 0.2 acres
- Electrical/chemical buildings = 0.15 acres
- Roadway to cooling tower = 0.5 acres
- Permanent parking lot = 1.0 acres

2.9.2 Air Quality

OCGS is located in an air quality control region that is classified as a moderate non-attainment area under the 8-hour ozone National Ambient Air Quality Standard (NAAQS) and a maintenance area under the carbon monoxide (CO) NAAQS (40CFR81.331).

The cooling towers proposed for OCGS are a hybrid wet/dry system that effectively reduces or eliminates a visible plume and ground fog. In a wet cooling tower, the leaving air stream is saturated with water vapor. This plume of saturated air can be highly visible because it is usually warmer, and contains considerably more moisture, than the surrounding atmospheric air. As it cools to reach equilibrium with the ambient air, its excess water vapor condenses because cold air is incapable of assimilating as much moisture (specific humidity) as warm air. This condensed plume of moisture becomes visible as fog. The hybrid system produces a stream of heated dry air that is mixed with the saturated air prior to its exit from the tower. This results in desaturation of the plume to the point where very little, if any, condensation can occur as the plume is cooled to ambient conditions (Marley 2005). So visible plumes or ground fogs are negligible or eliminated and associated impacts would be avoided.

The primary pollutant of concern from operation of a hybrid cooling tower at OCGS is particulate matter less than 10 micrometers in diameter (PM10). In wet-evaporating cooling towers there is always a certain amount of water in the form of drift (water droplets) containing dissolved solids

that would exit through the cooling tower stacks. As the drift evaporates, the dissolved solids would form particulates (PM10). To minimize PM10 emissions, the OCGS cooling towers would incorporate drift elimination devices, which would maintain drift at a level of 0.0005% of the amount of circulating water flow.

The amount of PM10 is proportional to the amount of drift and the total dissolved solids in the circulating water. Based on the conceptual model design specifications, water quality data, and expected maximum cycles of concentration, PM10 emissions are estimated to be 261 tons per year (tpy) (AmerGen 2006). This exceeds the federal Prevention of Significant Deterioration (PSD) major source emission threshold level of 250 tpy (40CFR52.21). Therefore, the cooling towers would be subject to PSD review and permitting requirements.

3.0 Analysis of Impacts of Operations

RAI (3)

> ***Provide any assessments of the environmental issues using the issue categories enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 for cooling tower systems during normal operation.***

Response

Potential impacts of cooling tower systems during normal operation include water use and quality, groundwater, aquatic, atmospheric, noise, visual, terrestrial, and regulatory effects. With respect to Table B-1 of Appendix B to Subpart A of 10 CFR Part 51, these effects relate to certain issues listed in the following general categories:

- Surface Water Quality, Hydrology, and Use (for all plants)
- Aquatic Ecology (for all plants)
- Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)
- Groundwater
- Terrestrial Resources
- Air Quality
- Human Health
- Socioeconomics

AmerGen has made the following assumptions regarding the operations of the hybrid cooling towers selected for the analysis:

- 24 additional workers (operations, security and maintenance) would be required during normal operation.
- The additional workers would come from within the 50-mile radius

Using the indirect multiplier appropriate for Ocean County and used in the environmental report (2.7084) (AmerGen 2005, Section 3.4), AmerGen estimates 24 direct jobs would result in 41 indirect jobs. All 41 indirect jobs would be filled from within the 50-mile radius.

The taxable portion of the project would be approximately $300 million. In the GEIS, Section 4.7.2, NRC defines significance levels for tax impacts. Impacts from new tax payments would

be of small significance when new tax payments are less than 10 percent of the taxing jurisdiction's revenue. In 2003, OCGS tax payments represented 4.1 percent of Lacey Township property tax revenues. It is unlikely that the increase in plant value attributed to the addition of cooling towers would cause the OCGS tax payment to more than double to more than 10 percent of Lacey Township's property tax revenues.

The Seasonal Annual Cooling Tower Impact Code (SACTI; EPRI 1987) was used to evaluate impacts of salt drift from linear, hybrid mechanical draft cooling towers proposed for OCGS. The drift was modeled in the normal, spring, summer and fall operational modes. The results indicate that in the region near the switchyard, up to 60 lbs of salt per acre per month could be deposited in the fall. On average, at 800 m (2,600 feet) and beyond, salt deposition remained below the NRC level of significance (NRC 1999) of 8.9 lbs per acre per month for visible leaf damage. However, in the W direction, deposition is 22 lbs per acre per month at 800 m (2,600 feet) in the spring. As shown in Table 2-1, deposition in the W direction falls below the NRC level of significance between 1,300 m (4,300 feet) and 1,400 m (4,600 feet).

Table 2-1. Deposition of salts from cooling tower drift in the W direction during spring.

Distance (m)	1,000	1,100	1,200	1,300	1,400	1,500
Deposition (lb/acre/month)	10.0	10.9	10.6	9.9	7.1	4.0

Table (3)-1 presents assessments of issues enumerated in NRC Table B-1 that are applicable to cooling tower systems during normal operation.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation

Issue	Impacts
Surface Water Quality, Hydrology, and Use (for all plants)	
3. Altered current patterns at intake and discharge structure	Altered current patterns is a Category 1 issue for once-through systems because of drastic increases in flow over ambient conditions. Section 4.2.1.2.1 of the GEIS (NRC 1996) discusses the impacts of the current patterns caused by OCGS on the Forked River and Oyster Creek. The creeks went from alternating flows typical of estuarine streams to unidirectional flow with constant salinity. The flow in Forked River and Oyster Creek is due to the intake and dilution pumps for the current once-through cooling water system. Concern was expressed about the impact of reduced pumping on the flow in the two creeks, and the changes in water quality and fish habitat caused by the cooling-tower system's reduction in flow. Under the current system, intake is 460,000 gpm to the condensers plus 260,000 gpm to each of two dilution pumps. The hybrid cooling tower system would require 14,000 gpm of makeup to the cooling towers and one 260,000 gpm dilution pump. This constitutes approximately 28% of the current water intake. Discharge would be reduced to 7,000 gpm blowdown plus 260,000 gpm of dilution flow, approximately 27% of the current once-through discharge system. Even with this significant reduction in intake and discharge, it is expected that water quality in the creeks will be maintained, because uni-directional flow would be maintained that is much greater than original flow in the two creeks (11,200 gpm from Oyster Creek and 1,350 gpm from Forked River, albeit freshwater [Jersey Central Power and Light Company 1972]). AmerGen concludes that environmental effects due to altered current patterns would be minimal therefore impacts would be SMALL.
4. Altered salinity gradient	The GEIS Section 4.2.1.2.2 concluded that altered salinity gradients was a Category 1 issue, though OCGS was specifically discussed because the flows of the Forked River and Oyster Creek were converted from brackish tidal to unidirectional with the same salinity as Barnegat Bay. The volume of cooling tower blowdown (7,000 gpm) would not alter the salinity of the Oyster Creek flow. One dilution pump would continue to operate, at a rate of 260,000 gpm to maintain flow through the two creeks and the blowdown would mix with this much greater flow. AmerGen concludes that this impact would be SMALL.
9. Discharge of chlorine and other biocides	Biocides would be those typically used for cooling tower maintenance. An NPDES permit would be required to discharge effluents into surface water. The GEIS (Section 4.3.2.2) concludes that the impacts of cooling tower discharges are of small significance (Category 1) if water quality criteria (i.e., NPDES permit limits) are not consistently violated. OCGS discharges currently meets permit limits, and AmerGen would ensure that any discharges from the cooling towers remained within NJPDES limits. AmerGen concludes that this impact would be SMALL.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue	Impacts
Aquatic Ecology (for all plants)	
16. Entrainment of phytoplankton and zooplankton	The GEIS Section 4.3.3 discusses the impacts of closed-cycle cooling systems on aquatic ecology and concludes that all are Category 1 issues. The GEIS concludes that impact from entrainment of phytoplankton and zooplankton is SMALL.
17. Cold shock	The GEIS concludes that impacts from cold shock from a closed-cycle cooling system is a Category 1 issue and impacts would be SMALL.
18. Thermal plume barrier to migrating fish	The GEIS concludes that thermal plumes from a closed-cycle cooling system would not block fish passage and therefore is a Category 1 issue and impacts would be SMALL.
Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)	
28. Entrainment of fish and shellfish in early life stages	Entrainment of fish and shellfish in early life stages is a Category 2 issue for plants with once-through heat dissipation systems. Due to the reduced flows the GEIS Section 4.3.3 concludes this is a Category 1 issue for cooling-tower based heat dissipation systems, unless an unusually important resource (e.g., threatened or endangered species) is affected. As discussed in Section 2.5 of the License Renewal ER (AmerGen 2005), special-status fish or shellfish species have not been recorded near OCGS and entrainment of fish and shellfish has not been an issue at OCGS. Thus, the cooling tower system is expected to result in insignificant entrainment of fish and shellfish in early life stages. AmerGen concludes that impacts would be SMALL.
29. Impingement of fish and shellfish	The GEIS concludes that impingement of fish and shellfish is a Category 1 issue for cooling-tower based heat dissipation systems, unless an unusually important resource (e.g., threatened or endangered species) is affected. Special-status fish and shellfish have not been recorded in the area (see Section 2.5 of AmerGen 2005). Thus, the cooling tower system is expected to result in insignificant impingement of fish and shellfish. As discussed in Section 2.5, impingement of sea turtles has occurred on the OCGS intake trash rack. The reduced flow (see discussion of Issue 3, above) would result in less likelihood of sea turtle impingement. AmerGen concludes that impacts would be SMALL.
30. Heat shock	The GEIS concludes that impacts of heat shock from a closed-cycle system is a Category 1 issue and impacts would

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue	Impacts
	be SMALL.
Groundwater Use and Quality	
37. Groundwater quality degradation (saltwater intrusion)	Section 4.8.2 of the GEIS evaluated impacts of groundwater withdrawal for any purposes, including dewatering. Groundwater withdrawal on coastal aquifers can adversely impact the quality of the freshwater aquifer by inducing saltwater intrusion. The GEIS notes that operational dewatering is not taking place at any of the estuarine or coastal sites. The potential for saltwater intrusion is considered to be of small significance because groundwater consumption by nuclear plants is a small fraction of groundwater use. Therefore, the GEIS concludes that groundwater withdrawal is a Category 1 issue and impacts would be SMALL. OCGS is in a Water Supply Critical Area where excess use poses a threat to the long-term water supply source. Section 2.3 of the license renewal environmental report (ER) (AmerGen 2005) described the aquifers in the vicinity of OCGS. The NJ Water Supply Administration regulates all groundwater diversions of 100,000 gpd or greater. The greatest concern is the integrity of the deep aquifers. AmerGen concludes that impacts would be SMALL.
Terrestrial Resources	
41. Cooling tower impacts on crops and ornamental vegetation	The hybrid cooling system will largely eliminate plume-induced fogging and cloud cover, plume-induced icing, and associated increases in relative humidity, and thus, concomitant impacts on crops and ornamental vegetation from tower-related fogging, humidity, and icing will be negligible. The GEIS states that beyond about one mile from nuclear plant cooling towers, salt deposition is not significantly above natural background levels, and concludes that cooling tower impacts on crops and ornamental vegetation is a Category 1 issue. As discussed above, salt deposition beyond 800 m (2,600 feet) from the towers is expected to be less than the NRC level of significance of 8.9 lbs per acre per month for visible leaf damage (NRC 1999), except in the W direction, where deposition is predicted to exceed 8.9 lbs per acre per month to a distance of 1,300 m (4,300 feet). Because there are no crops or agricultural areas in the vicinity of OCGS, impacts to crops from salt deposition are not expected. AmerGen concludes that impacts to ornamental vegetation would be SMALL to MODERATE.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue	Impacts
42. Cooling tower impacts on native plants	As stated in the discussion of issue 41, the hybrid cooling system will largely eliminate plume-induced fogging and cloud cover, plume-induced icing, and increased relative humidity. However, the high salt content of the makeup water will result in relatively high salt deposition in the immediate vicinity of the cooling towers. Specifically, modeling suggests that salt deposition will exceed the NRC level of significance of 8.9 lbs per acre per month for visible leaf damage (NRC 1999) within 800 m (2,600 feet) of the towers and out to 1,300 m (4,300 feet) W of the towers. Increased salt deposition might impact local vegetation, including habitat considered pinelands, and nearby freshwater wetlands, some of which occur at OCGS. The Edwin B. Forsythe National Wildlife Refuge is located adjacent to Lacey Township's Eno's Pond County Park, about two miles northeast of the proposed cooling towers, and beyond the area of increased salt deposition. AmerGen concludes that impacts on native vegetation would be SMALL to MODERATE.
43. Bird collisions with cooling towers	The GEIS concludes that although collisions with natural draft cooling towers cause some avian mortality, the issue would be of small significance. The GEIS also concludes that mechanical draft cooling towers (which are not nearly as tall as natural draft cooling towers) pose little collision-risk to birds. The proposed cooling towers at OCGS would be 80 feet high, and would pose negligible collision-related risk to birds. AmerGen concludes that impacts would be SMALL.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue	Impacts
Air Quality	
Air quality (not considered an operational impact in the GEIS)	AmerGen performed a screening analysis of the impact of PM10 emissions on air quality in the area using EPA's SCREEN3 model (EPA 1995a). Results of the screening analysis indicate that PSD ambient air quality PM10 increments, National Ambient Air Quality Standards (NAAQS), and New Jersey Ambient Air Quality Standards (NJAAQS) would not be achieved. Incremental PM10 concentrations at the nearest site boundary would exceed the allowable 24-hour and annual PSD Class 2 increments. When added to the background concentration the total PM10 concentration at the site boundary would exceed the NAAQS 24-hour PM10 primary standard and the NJAAQS annual total suspended particulate (TSP) secondary standard. The Brigantine National Wildlife Refuge which is approximately 25 miles to the south of OCGS is a PSD Class 1 area. Results of the screening analysis indicate that PSD PM10 increments for Class 1 areas would be met, but OCGS PM10 emissions would exceed Class 1 significant impact levels and additional analyses would be required to evaluate impacts of regional haze and deposition in the refuge. Because the dispersion modeling predicts impacts that exceed required levels, AmerGen would need to reduce the particulate emission rate. Since the most efficient drift eliminator technology currently available is already incorporated in the conceptual model, the only way to reduce particulate emissions is to reduce the Total Dissolved Solids and Total Suspended Solids concentration in the cooling tower circulating water. This can be accomplished by reducing the cycles of concentration or pretreatment of the sea water, i.e., desalinization. Desalinization is cost prohibitive and reducing the cycles of concentration diminishes the capability of the hybrid towers to reduce cooling water flow. The purpose of pursuing cooling towers is to reduce the impacts of high flow on aquatic populations. AmerGen concludes that impacts would be MODERATE. *Indirect Air Quality Impacts* Based on the conceptual model design specifications, replacement of the existing once-through cooling system with the hybrid tower system would result in a net average generation loss of 32.5 MW(e). This generation would likely be replaced by increased utilization of existing fossil-fuel-fired generating plants resulting in an increase in emissions of criteria pollutants at those plants. The emissions produced as a result of this increased fossil fuel usage would depend on a variety of factors including fuel type, plant location, and plant efficiency. The majority of fossil plants in New Jersey are older plants that are less efficient and tend to emit more air contaminants than the plants being built today. Based on an average annual capacity factor of 92 percent for OCGS and average air contaminant emission rates for New Jersey's fleet of fossil-fuel-fired generating plants (EIA 2005a, 2005b; EPA 2005), potential increases in air emissions at the fossil fuel plants from replacement of the lost generation at OCGS would be approximately 501 tpy SOx, 356 tpy NOx, 1134 tpy CO, and 807 tpy PM10.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue		Impacts
On-Site Land Use		
52.	Onsite land use	OCGS is within a Coastal Fringe Planning Area as defined by the New Jersey Coastal Area Facility Review Act (CAFRA), which limits the amount of impervious cover. OCGS is included in the proposed CAFRA-designated Town Center of Lacey Township, which currently has an impervious cover limit of 70 percent. Lacey Township has requested that New Jersey reinstate the Town Center designation through March 2007. Lacey Township has also requested that the State designate it a CAFRA Regional Center, which would raise its impervious surface limit to 80 percent. If the township is not successful, the impervious limit at OCGS reverts to 5 percent. At present, OCGS is at 65 percent of its allowable impervious cover. Through March 2007, if New Jersey reinstates the Town Center designation for an additional year, OCGS can pave an additional 32.5 acres. The requirements after March 2007 are not known at this time. AmerGen concludes that impacts to onsite land use would be MODERATE to LARGE.
Human Health		
56.	Microbiological organisms (occupational health)	The threat of *Legionella* and *Naegleria* that currently exists in the plant's condenser water boxes and tubes is very small, given that these organisms are freshwater pathogens. In freshwater plants where these organisms exist, cooling towers, as well as condensers, are potential sources of infection. The GEIS section 4.3.6 concludes that this issue is Category 1, even for freshwater plants. AmerGen concludes that impacts would be SMALL.
57.	Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	Table A-1 of the OCGS license renewal environmental report states that the issue of microbiological organisms does not apply at OCGS. OCGS is an estuary or coastal site (Table 5.13 of the GEIS), not using a cooling lake or canal and not using cooling towers or ponds that discharge to a small river. With the addition of the cooling towers, one must consider if Oyster Creek (the creek) could be considered a small river. It is not so identified in Tables 5.18 or 5.19 of the GEIS. The water in Forked River and Oyster Creek is unidirectional flow of Barnegat Bay and has the same water quality as the Bay, therefore is considered to be an estuary in the GEIS. *Naegleria fowleri* is a freshwater pathogen, and Oyster Creek is saltwater. Furthermore, the threat of *Naegleria* infections in Oyster Creek if OCGS used cooling towers is less than any current threat because both the volume and temperature of the cooling tower blowdown would be much less than that currently discharged from the plant's once-through system. AmerGen concludes that impacts would be SMALL.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue	Impacts
58. Noise	Earlier studies of a round mechanical draft cooling tower (GPU 1992) indicated that noise from a round mechanical draft cooling tower operating at full fan speed would exceed New Jersey and Lacey Township ordinances. More recent studies (AmerGen 2006) indicated more noise would emanate from the hybrid tower being considered than from the round mechanical draft tower because of the hybrid tower's heat exchangers and mixing in the plenum of the tower. In addition, the nearest residential property considered the GPU report would have been 2,250 feet from the cooling towers. The nearest residence considered in the AmerGen report would be 1,800 feet from the cooling towers. Due to security requirements, nuclear plants must maintain clear lines of sight. This negates noise reduction by constructing berms or other sound barriers. AmerGen would need to obtain variances from the noise ordinances, and/or buy land easements for noise abatement or determine what type of silencing packages, if any, could meet the security requirements and the state and local noise ordinances. AmerGen concludes that impacts would be MODERATE to LARGE.
61. Radiation exposure to the public (license renewal term)	Section 4.6.5.2 of the GEIS concludes that because all plants operate below regulatory limits and therefore doses to the public are below regulatory limits, this is a Category 1 issue and impacts are small. Contamination of the circulating water system is highly improbable. Therefore, there is no pathway to expose the general public to radiation from cooling tower operation. The GEIS does not identify any issues with public exposure from cooling tower operation at BWRs. Public radiation exposure during plant operations is a Category 1 issue. AmerGen concludes that impacts would be SMALL.
62. Occupational radiation exposures (license renewal term)	Normal operation of the cooling towers would not involve radioactive materials. Consequently, there would be no increase in radiation levels or emissions. Plant workers would not experience increased doses due to normal cooling tower operation. Occupational radiation exposures at nuclear plants (GEIS Section 4.6.3) is a Category 1 issue. AmerGen concludes that impacts would be SMALL.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue	Impacts
Socioeconomics	
63. Housing impacts	The GEIS Section 4.7.1 states that the potential for operations-related impacts to housing would be caused by among other things, increased staffing. Further, NRC states that impacts on housing would be considered to be of small significance when a small and not easily discernible change in housing availability occurs, generally as a result of a very small demand increase or a very large housing market. For the cooling tower project, operations-related new jobs (24 direct and 41 indirect) would be filled by residents within the 50-mile radius of the OCGS site. AmerGen concludes that impacts to housing availability resulting from cooling tower operation population growth would be SMALL.
64. Public services: public safety, social services, and tourism and recreation	The GEIS Section 4.7.3 states that the potential for operations-related impacts to public services would be caused by increased staffing, specifically, in-migrating workers. All operations-related new direct and indirect jobs would be filled by residents within a 50-mile radius of the OCGS site. AmerGen concludes that impacts resulting from plant-related population growth to public services would be SMALL.
65. Public services: public utilities	The GEIS, Section 4.7.3.5 states that the potential for operations-related impacts to public utilities would be caused by increased staffing, specifically in-migrating workers. Further, NRC states that an increased problem with water availability may occur in conjunction with plant demand and plant-related population growth as a result of current water shortages in some areas. These shortages may result in moderate impacts to public water supplies at sites with limited water availability. All operations-related new direct and indirect jobs would be filled by residents within a 50-mile radius of the OCGS site. AmerGen concludes that impacts resulting from plant-related population growth to public water supplies would be SMALL.
67. Public services: education (license renewal term)	The GEIS Section 4.7.3.1 states that the potential for operations-related impacts to education would be of small significance. AmerGen concludes that impacts resulting from plant-related population growth to public services would be SMALL.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue	Impacts
69. Offsite land use	The GEIS, Section 4.7.4.1 made impacts to off-site land use as a result of operations activities a Category 2 issue because land-use changes could be considered beneficial by some community members and adverse by others. Site-specific factors to be considered in an assessment of new tax-driven land-use impacts include: (1) the size of plant-related population growth compared to the area's total population, (2) the size of the plant's tax payments relative to the community's total revenue, (3) the nature of the community's existing land-use pattern, and (4) the extent to which the community already has public services in place to support and guide development. The GEIS concluded that if the plant's tax payments are small, relative to the community's total revenue, new tax-driven land-use changes would be small, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. At OCGS, the population increase associated with cooling tower operations would represent much less than five percent of the local area's total population. Ocean County is the fastest growing county in New Jersey. The addition of the cooling towers would result in a small increase in the plant's property tax revenues to Lacey Township and Ocean County. However, the local tax base is very large and the increase in tax payments would be comparatively small. Any changes to the infrastructures of Lacey Township and Ocean County would be attributable to the large population immigration already experienced by the County, and a large pool of residential, industrial, and commercial tax payers. AmerGen concludes that land-use impacts would be SMALL.
70. Public services: transportation	The GEIS Section 4.7.3.2 states that the potential for operations-related impacts to transportation would be caused by increased staffing. OCGS's workforce includes approximately 470 permanent and 150 contract employees. As many as 1,300 additional workers join the permanent workforce during a refueling outage, which typically lasts approximately 20 days. Twenty-four additional employees would be required for the life of the plant as a result of the addition of cooling towers, which is less than 1 percent of the employees on site during an outage. On Route 9, in the vicinity of OCGS, the average range of vehicles per day is 14,660 to 20,926. Twenty-four employees would represent an indiscernible increase in these traffic volumes. AmerGen concludes that impacts to transportation would be SMALL.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue	Impacts
71. Historic and archaeological resources	The GEIS, Section 4.7.7 states that the potential for operations-related impacts to historic and archaeological resources could be caused by increased staffing and/or operations activities. The cooling tower project would not result in cultural resource impacts due to staffing increases. As stated in the OCGS License Renewal ER (AmerGen 2005), there are no known cultural resources at the OCGS site. In addition, Exelon's corporate procedures insure the protection of known and newly discovered cultural resources. AmerGen concludes that any potential impacts resulting from cooling tower operations on cultural resources would be SMALL.

Table 3-1. Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51 That Are Applicable To Cooling Tower Systems During Normal Operation (Continued)

Issue	Impacts
72. Aesthetic Impacts (license renewal term)	The GEIS Section 4.7.8 analyzes impacts on aesthetic resources from continued operations. Based on the assumption in the GEIS that new visual impacts are not expected during the license renewal term, NRC concludes that, because license renewal will not alter the visual intrusiveness of any plant, the number of individuals having negative perceptions would probably remain constant. This assumption is not valid for new cooling towers at OCGS, nor may the conclusion be valid. However, the NRC's definitions of Small, Moderate, and Large for aesthetics impacts may be sufficient to extend to the OCGS cooling tower project and are as follows: Small – (1) there are no complaints from the affected public about a changed sense of place or a diminution in the enjoyment of the physical environment and (2) there is no measurable impact on socioeconomic institutions and processes. Moderate – (1) there are some complaints from the affected public about a changed sense of place or a diminution in the enjoyment of the physical environment and (2) measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes. Large – (1) there is a continuing and widely shared opposition to the plant's continued operation based solely on a perceived degradation of the area's sense of place or a diminution in the enjoyment of the physical environment and (2) measurable social impacts that perturb the continued functioning of community institutions and processes. The OCGS site is zoned Industrial. The addition of two mechanical draft cooling towers and two pump houses would not constitute a change in the site's character. Members of the public have opposed OCGS for a variety of reasons including the degradation of the environment (which includes aesthetic degradation). It is impossible to measure the degree of public opposition to the OCGS based solely on aesthetic degradation; however, it is known that there is some level of opposition. The addition of the cooling tower facilities could renew or inspire new opposition, however, it is unlikely that the addition of cooling towers would cause sufficient public opposition to noticeably alter socioeconomic institutions and processes. AmerGen concludes that potential impacts on aesthetics would be SMALL to MODERATE.

4.0 Analysis of Impacts of Construction

RAI (4)

The staff believes that impacts associated with the construction of a closed-cycle cooling system would need to be assessed in Chapter 8 of the Oyster Creek license renewal SEIS along with impact of operation [RAI (3)]. It is quite likely that some or all of the construction would be performed during the renewal period. Provide any assessments of the environmental issues related to the construction of cooling tower systems using the issues categories enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 for refurbishment impacts for major components as a guide.

Response

In general, the assessment of environmental issues related to cooling tower systems is bounded by those in NRC Table B-1 and detailed in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants. However, the issues in each applicable general category must be examined to ensure that the assumptions do indeed envelope the impacts of cooling tower construction. This examination reveals that there are certain exceptions to this general rule. For example, the GEIS and Table B-1 indicate that ground water dewatering is not an expected activity during refurbishment while extensive dewatering would be required to install the conduits required to convey circulating water to and from the cooling towers.

AmerGen has made the following assumptions regarding the construction of cooling towers at OCGS.

- The duration of construction would be two years
- For 150 days there would be 200 construction workers on site divided between two shifts
- For the balance of two years there would be 100 construction workers on site divided evenly between two shifts
- The construction workforce would come from within the 50-mile radius

For this analysis, potential impacts related to the construction of cooling tower systems are analogous to the refurbishment issues in Table B-1. These effects relate to the following general categories:

- Surface Water Quality, Hydrology, and Use (for all plants)
- Aquatic Ecology (for all plants)
- Groundwater Use and Quality
- Terrestrial Resources
- Air Quality
- Human Health
- Socioeconomics

Table 4-1 presents assessments of refurbishment issues enumerated in Table B-1 that are applicable to hybrid cooling tower systems construction.

Table 4-1 Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51That Are Applicable To Hybrid Cooling Tower Systems Construction

Issue	Impacts
Surface Water Quality, Hydrology, and Use (for all plants)	
1. Impacts of refurbishment on surface water quality	Although the GEIS assumed that most refurbishment impacts would occur in existing structures (NRC 1996), it does account for some outdoor activities, and expects impacts to be minimal. Impacts of cooling tower construction on surface water quality are expected to be negligible because best management practices would be employed to control soil erosion and contaminant spills. AmerGen concludes that impacts would be SMALL.
2. Impacts of refurbishment on surface water use	Surface-water use would not increase during construction of cooling tower systems. AmerGen concludes that impacts would be SMALL.
Aquatic Ecology (for all plants)	
14. Refurbishment impacts to aquatic resources	Construction impacts (e.g., reduced entrainment, reduced impingement, reduced chemical releases, reduced water consumption during the time the reactor was in a construction outage) would have no adverse impacts on aquatic biota. The GEIS (NRC 1996) considers activities similar to those of cooling system construction such as replacement of large components of the nuclear steam supply system, repair or replacement of pumps, pipes, electronic circuitry, electrical and plumbing systems, or motors. The GEIS concludes that this is a Category 1 issue for nuclear power plants and impacts would be SMALL.
Ground-water Use and quality	
31. Impacts of refurbishment on ground-water use and quality	Based on evaluations in the GEIS (Section 3.4.2), groundwater dewatering on sites near the ocean [e.g., OCGS] can adversely affect groundwater quality by introducing saltwater intrusion. OCGS is in a Water Supply Critical Area where excess use poses a threat to the long-term water supply source. The NJ Water Supply Administration regulates all groundwater diversions of 100,000 gpd or greater. The greatest concern is for the integrity of the deep aquifers. The cooling water system would require trenching up to 40 feet below sea level (60 feet below ground surface) to install the 12-foot diameter conduit that returns the circulating flow to the cooling towers. Substantial dewatering of the shallow aquifer would be required during construction. As required, AmerGen would obtain certification from the New Jersey Department of Environmental Protection that it is in compliance with the New Jersey Coastal Management Program. Included in that program are Coastal Zone Management Rules, which require that groundwater withdrawal not cause salinity intrusions into the groundwater. AmerGen would monitor the groundwater during the period of installing the 12 foot conduit to ensure that salinity intrusion does not occur. AmerGen concludes that impacts would be SMALL to MODERATE.

Table 4-1 Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51That Are Applicable To Hybrid Cooling Tower Systems Construction (Continued)

Issue	Impacts
Terrestrial Resources	
40. Refurbishment impacts to terrestrial resources	Refurbishment impacts to terrestrial resources would be small if no loss of important habitat occurs, but could be moderate or large depending on the extent to which important habitat exists and could be affected. Because the significance of ecological impacts cannot be determined without considering site-specific and project-specific details, and because mitigation may be warranted, the GEIS concludes that [construction] impacts on terrestrial resources are a Category 2 issue. Construction of the cooling towers would require the disturbance of approximately 13.5 acres at OCGS, approximately 10.5 acres of which would eventually be impervious area (e.g., structures, roads, parking lots). Existing land cover consists of grasses, shrubs and several mature trees. Freshwater wetlands and transition areas are present in the vicinity and are protected by a deed restriction. N.J.A.C. 7:7E-3.28 establishes a buffer of up to 300 feet adjacent to coastal wetlands. Although the cooling tower layout will avoid the wetlands as much as possible, unavoidable permanent and temporary disturbances of wetlands and transition areas on the site (if any) will require a Freshwater Wetlands Permit and Transition Area Waiver from NJDEP. A wetland delineation and transition area determination will be undertaken prior to applying for the waiver. Previous rare, threatened and endangered species (RTE) surveys at OCGS suggest that habitat suitable for state threatened animal species (Pine Barrens tree frog, northern pine snake, wood turtle, barred owl, and Cooper's hawk) and rare wetland plant species (New Jersey rush, Pine Barrens boneset, curly grass fern) might occur on-site. RTE species and habitat assessments will need to be conducted. The potential constraints imposed by the identification of on-site RTE species or critical habitats are unknown. AmerGen concludes impacts of cooling tower construction on terrestrial resources would be SMALL to MODERATE.

Table 4-1 Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51That Are Applicable To Hybrid Cooling Tower Systems Construction (Continued)

Issue	Impacts
Air Quality	
50. Air quality during refurbishment (nonattainment and maintenance areas)	Emissions generated during construction principally consist of exhaust emissions (CO, sulfur oxides [SOx], nitrogen oxides [NOx], volatile organic compounds [VOC], and particulate matter [PM10]) from operation of heavy-duty construction equipment, delivery vehicles, and worker's personal vehicles; fugitive dust (PM10) from disturbed soil; and VOC emissions from asphalt paving and painting. As discussed in Section 3.3 of the GEIS, air quality impacts from these sources would be minor and of short duration. The amount of pollutants emitted from construction vehicles and equipment and construction worker commute traffic would be small compared to total vehicular emissions in the region. The disturbed area for the cooling towers, pipelines, roadways, and laydown areas, is estimated to be 13.5 acres. The small amount of disturbed area and implementation of best management practices (e.g., watering, silt fences, covering soil piles, revegetation, etc.) would minimize the amount of fugitive dust generated during construction. Also, particulate matter in the form of fugitive dust consists primarily of large particles that settle quickly and thus have minimal adverse public health effects. As noted in Section 3.3 of the GEIS (NRC 1996), a conformity analysis is required for each pollutant where the total of direct and indirect emissions caused by a proposed federal action would exceed established threshold emission levels in a nonattainment or maintenance area. Due to Ocean County's ozone nonattainment status, the generation of NOx and VOC, which combine in the presence of heat and sunlight to create ozone, are a source of concern. The generation of CO is also a potential source of concern due to the county's status as a CO maintenance area. New Jersey's threshold rates are a net increase of 25 tons per year (tpy) for VOC, 25 tpy for NOx and 100 tpy for CO (NJAC 7:27-18.7, Table 3). AmerGen calculated emissions from construction activities using estimates of the types and number of and vehicles required, typical VOC content of architectural coatings, and U.S. Environmental Protection Agency (b) AP-42 emission factors (EPA 1995b). The total emission rates for VOC (23.3 tpy), NOx (24.4 tpy) and CO (19.7 tpy) are less than their corresponding significant threshold rates; therefore, a conformity determination would not be required. AmerGen concludes that impacts to air quality would be SMALL.

Table 4-1 Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51That Are Applicable To Hybrid Cooling Tower Systems Construction (Continued)

Issue	Impacts
Land Use	
52. On-site land use	The GEIS, Section 3.2 assumes that major refurbishment-related impacts to on-site land use generally disturb 2.5 to 10 acres and that, often, the land is returned to its prior use or to long-term storage of materials. Based on these assumptions, NRC concludes that the change in on-site land use due to refurbishment is a Category 1 issue. AmerGen proposes to construct two cooling towers and associated infrastructure on a 27.7-acre area west of Route 9, adjacent to the intake canal. The existing land cover comprises grasses, shrubs, and several mature trees. Freshwater wetlands and transition areas are present and protected by a deed restriction, rendering 7.8 acres unbuildable. Thirteen and one/half acres would be disturbed. Of that 13.5 acres, 10.5 acres would be covered by impervious surfaces. Approximately 150,000 cubic yards of soil would be excavated, all of which would be used as fill material; there would be no need for offsite disposal of excavated material. The scope of this project is not bounded by the GEIS analysis. However, the site is already owned by AmerGen, and has an industrial facility on it. The addition of the cooling tower facilities would not change the existing site character. AmerGen would need to obtain exemptions from two local land use ordinances for this project: • nonconforming land use • expanded security fence. The site is zoned M-6 Industrial and is bounded by M-1 zoning to the north, M-6 to the west, C-100 to the east and M-2 to the south. General Industrial (I-1)and Residential (R-1) are located approximately 1,700 feet to the northeast and Waterfront Development (WD) is approximately 3,000 feet to the southeast. A number of uses are prohibited in M-1, M-2, and M-6 Zones. One of these is the manufacture of electricity. OCGS is considered a nonconforming use. The Lacey Township Zoning Ordinance (Chapter 335), Article V Nonconforming Uses and Structures, § 335-38 Continuance, states an existing nonconforming use may be continued provided that:(A). No nonconforming structure shall be enlarged, extended, or increased unless by such action it complies with this chapter, (B). No nonconforming use shall be expanded, (C). No nonconforming lot shall be further reduced in size. To qualify for a variance, a number of performance standards would need to be met for the M-6 Zone. They include, but are not limited to, control of noise, dirt, dust, fly ash, fumes, vapors, gases, glare or heat, and vibration. Lacey Township officials would likely review these potential impacts when choosing whether or not to grant a variance. The Lacey Township Zoning Ordinance (§ 335-22), limits the height for rear and side yard fencing to six feet. A variance would be needed for higher security fencing. AmerGen concludes that impacts would be SMALL to MODERATE. However, the ability to get exemptions from the Township is not known at this time.

Table 4-1 Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51That Are Applicable To Hybrid Cooling Tower Systems Construction (Continued)

Issue	Impacts
Human Health	
54. Radiation exposures to the public during refurbishment	The construction of the cooling towers would not involve radioactive materials. Consequently, there would be no increase in radiation levels or emissions. No member of the public would receive a radiation dose due to construction of cooling towers. AmerGen concludes that impacts would be SMALL.
55. Occupational radiation exposures during refurbishment	AmerGen monitors radiation in the vicinity of the plant using thermoluminiscent detectors (TLDs). The data from this monitoring program are reported in the Annual Radiological Environmental Operating Report. The TLD monitoring locations closest to the location of the cooling towers are numbers 51, 52, and 53. For these three locations, the doses for 2004 ranged from 12.3 to 16.5 milliroentgen per quarter, with a mean value of 14.1 milliroentgen per quarter. A control point more than 20 miles from OCGS recorded values ranging from 9.5 to 13.6 milliroentgen per quarter with a mean of 11.2 milliroentgen per quarter. Therefore, the contribution from OCGS to locations 51, 52, and 53 is approximately 2.9 milliroentgen per quarter or 2.3 microrem per hour assuming equivalence between roentgens and rem. This is more than three orders of magnitude below a radiation area as defined by NRC regulations in 10 CFR 20 (5 millirem per hour). The hypothetical construction of cooling towers would employ 200 workers for 22 weeks and 100 workers for 82 weeks, for a total of 12,600 person-weeks. These individuals could be exposed to the 2.3 microrem per hour dose rate. If each worker worked 50 hours per week, at the end of the project, the workforce would have received 1.5 person-rem. This compares to the single major refurbishment in the GEIS dose of 153 person-rem for BWRs, for which the GEIS concludes the impacts would be of small significance. AmerGen concludes that impacts would be SMALL.
Socioeconomics	
63. Housing Impacts	The GEIS Section 3.7.2 states that the potential for refurbishment-related impacts to housing would be caused by increased staffing. For the cooling tower project, construction jobs and any associated indirect jobs would be filled by residents within the 50-mile radius of the OCGS site. AmerGen concludes that impacts to housing would be SMALL.

Table 4-1 Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51That Are Applicable To Hybrid Cooling Tower Systems Construction (Continued)

Issue	Impacts
64. Public services: public safety, social services, and tourism and recreation	The GEIS Section 3.7.4 states that the potential for refurbishment-related impacts to public services would be caused by increased staffing, specifically in-migrating workers. All construction-related direct and indirect jobs would be filled by residents within a 50-mile radius of the OCGS site. AmerGen concludes that impacts resulting from construction-related population growth to public services would be SMALL.
66. Public Services, education (refurbishment)	The GEIS Section 3.7.4.1 states that the potential for refurbishment-related impacts to education would be caused by increased staffing, specifically, in-migrating workers. All construction-related direct and indirect jobs would be filled by residents within a 50-mile radius of the OCGS site. AmerGen concludes that impacts resulting from construction-related population growth to educational services would be SMALL.
68. Offsite land use (refurbishment)	NRC made impacts to off-site land use as a result of refurbishment a Category 2 issue because land-use changes could be considered beneficial by some and adverse by others. Local conditions to be ascertained include: (1) plant-related population growth, (2) patterns of residential and commercial development, and (3) population density and proximity to an urban area with a population of at least 100,000 (NRC 1996). Additionally, NRC stated that if plant-related population growth is less than 5 percent of the study area's total population, off-site land-use changes would be small. The population would not increase as a result of cooling tower construction. The cooling towers would increase OCGS's value by $300 million which would result in a small increase in property tax revenues to Lacey Township and Ocean County relative to total property tax revenues. AmerGen concludes that off-site land-use impacts from construction would be SMALL.

Table 4-1 Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51That Are Applicable To Hybrid Cooling Tower Systems Construction (Continued)

Issue	Impacts
70. Public transportation	The GEIS Section 3.7.4.2 states that refurbishment-related impacts to transportation would be caused by increased staffing and construction-related deliveries. AmerGen's OCGS workforce includes approximately 470 permanent and 150 contract employees. As many as 1,300 additional workers join the permanent workforce during a refueling outage. During peak construction, there would be a maximum of 200 construction workers, divided evenly between two shifts. The increase in employee traffic due to construction would not significantly affect traffic on nearby roads. Two hundred construction employees (at shift change) represent 15 percent of the normal outage commuters. On Route 9 in the OCGS vicinity, the annual average range of vehicles per day is 14,660 to 20,926. Two hundred employees twice a day would represent an indiscernible increase in these traffic volumes. AmerGen notes that there would be an increase in truck deliveries and has estimated a maximum of 20 trucks per day during the construction period. This increase in truck traffic would be indiscernible on Route 9. AmerGen concludes that impacts to transportation would be SMALL.
71. Historic and Archaeological Resources	The GEIS, Section 3.7.7 states that the potential for refurbishment-related impacts to historic and archaeological resources could be caused by increased staffing or construction activities. The cooling tower construction project would not result in cultural resource impacts due to staffing increases. Construction activities could result in impacts to cultural resources. However, as stated in the OCGS License Renewal ER, Section 2.11, there are no known historic or archaeological resources at the OCGS site. In addition, Exelon's corporate procedures insure the protection of known and newly discovered cultural resources. All land-disturbing activities would be done under the auspices of Exelon's corporate procedures that insure the protection of cultural resources. AmerGen concludes that any potential impacts resulting from cooling tower construction on cultural resources would be SMALL.

Table 4-1 Assessments of Issues Enumerated in Table B-1 of Appendix B to Subpart A of 10 CFR 51That Are Applicable To Hybrid Cooling Tower Systems Construction (Continued)

Issue	Impacts
72. Aesthetic impacts (refurbishment)	The GEIS Section 3.7.8 makes the assumption that most refurbishment activities would "be conducted on-site and primarily within existing buildings". Further, NRC states that, "Other than a possible increase in local traffic, due to refurbishment workers, refurbishment activities are not expected to be readily noticeable from off-site viewpoints at any plant. Thus, without a visible intrusion within the physical environment there is no stimulus that could lead to complaints from the public about a changed sense of place or diminution in the enjoyment of the physical environment and measurable impact on socioeconomic institutions and processes. For these reasons, the impact [of refurbishment] on aesthetic resources is found to be small. Because there will be no readily noticeable visual intrusion, consideration of mitigation is not warranted." These assumptions are not valid for the construction of new cooling towers at OCGS, nor may the conclusion be valid. A two-year construction period with associated noise, dust, and heavy equipment would be noticeable from Rt 9 and nearby residences (the nearest residence is approximately1700 feet from the property boundary). AmerGen concludes that potential impacts on aesthetics would be SMALL to MODERATE.

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