

APPENDIX 10.9
WATER SUPPLY ALTERNATIVES ANALYSIS AND
WATER CONSERVATION PLAN
TURKEY POINT UNITS 6 & 7

June 2009

1.0 Introduction

The existing Turkey Point Plant is situated on the approximately 11,000-acre property owned by Florida Power & Light Company (FPL) located in unincorporated southeastern Miami-Dade County (Figure 2.1.1-1). The Turkey Point plant property is bordered by Biscayne Bay to the east, and lies east of Florida City and the City of Homestead, Florida. The existing Turkey Point Plant consists of two nominal 400-megawatt (MW) natural gas/oil steam electric generating units (Units 1 & 2); two nominal 700-MW nuclear units (Units 3 & 4); and a nominal 1,150-MW natural gas-fired combined cycle unit (Unit 5). The Turkey Point plant property includes a 5,900-acre cooling canal system that serves Units 1 through 4 for cooling and Units 1 through 5 as an industrial wastewater facility. FPL owns the Everglades Mitigation Bank (EMB), which is a 13,000-acre natural wildlife and wetlands area located west and south of the Turkey Point plant property (see Figure 2.1.1-1).

The Site and vicinity characterization are described in detail in Chapter 3 of this SCA, the plant and directly associated facilities are described in Chapter 4, and the effects of construction and operations are described in Chapters 5 and 6, respectively.

An important component of developing a new nuclear power plant is the availability of adequate water to meet the cooling and process water requirements of the plant. Therefore, FPL conducted a systematic multiphase water supply alternative study to identify, evaluate and select the best cooling water supply plan for Turkey Point Units 6 & 7. The study resulted in the following recommendations:

- Reclaimed water from the Miami-Dade Water and Sewer Department (MDWASD) will be the primary supply of makeup water for the circulating water cooling system for Turkey Point Units 6 & 7.
- When reclaimed water cannot supply sufficient quantity or quality of water needed for cooling, additional makeup water will be saltwater supplied from radial collector wells (Secondary source) that are recharged from the marine environment (Biscayne Bay).

This appendix first summarizes the water demand components for Turkey Point Units 6 & 7 (Section 2), following the requirements of Section 2.4.2 of the Basis of Review (BOR) for Water Use Permit Applications within the South Florida Water Management District (SFWMD, October 14, 2008). Second, this appendix discusses the water supply alternative studies conducted for the facility (Section 3). Third, this appendix provides a Water Conservation Plan in Section 4.0 following the requirements of Section 2.4.1 of the BOR. The requirements of the BOR are being used to demonstrate that the water use for

Turkey Point Units 6 & 7 is reasonable and beneficial, efficient and in the public interest; and that it meets the substantive requirements of the SFWMD regulations.

2.0 Project Water Demand

In general, Turkey Point Units 6 & 7 will have three water demand requirements (a water use diagram is presented in Section 4.5 of the SCA):

1. Cooling water makeup to replace evaporation, blowdown and drift from the circulating water system cooling towers and the service water system cooling towers,
2. Process water, which is used primarily to make demineralized water for steam system makeup and for the reactor coolant system; and secondarily for washing operations and fire protection, and
3. Potable water for use by employees.

The cooling water demand depends on the source water quality and the cycles-of-concentration that can be achieved in the cooling towers. Because the total dissolved solids (TDS) content of reclaimed water is less than seawater, the cycles-of-concentration can be increased when reclaimed water is used. Therefore, Turkey Point Units 6 & 7 will require 55.3 million gallons per day (MGD) if supplied from reclaimed water or 124.4 MGD of cooling water to be supplied to the plant circulating water system if the water has salinity similar to seawater. The circulating water system will be designed to accommodate 100 percent supply from reclaimed water, 100 percent saltwater from radial collector wells, or a combination of the two sources. Makeup water for the service water, process water and potable water systems will be supplied to the Site from the MDWASD potable water supply. This water will also be the source for the demineralized water system, fire protection, and miscellaneous water uses. The table below summarizes the water demand requirements.

Two AP-1000 Units	Annual Average (MGD)	Monthly Maximum (MG)	Maximum Daily (MG)
Cooling Water (Circulation Water System, 100% reclaimed water source)	55.3	1,714	55.3
Cooling Water (Circulation Water System, 100% saltwater source)	124.4	3,857	124.4
Cooling Water (Service Water System, MDWASD potable supply)	0.7	74.4	2.4
Process Water (MDWASD potable supply)	0.6	36.6	1.2
Potable Water (MDWASD potable supply)	0.05	3.1	0.1

3.0 Water Supply Alternatives

FPL conducted a systematic multiphase water supply alternative study to identify, evaluate and select a cooling water supply plan that would best meet the quantity, quality and reliability requirements of the Turkey Point Units 6 & 7 Project. The first phase of the water supply alternatives study identified a list of 15 potential water source alternatives, organized into six categories, which, in concept, could meet some or all of the water requirements for Turkey Point Units 6 & 7. The alternatives included:

- 1) Marine Intakes
 - 1A Biscayne Bay Offshore Intake
 - 1B Card Sound Offshore Intake
 - 1C Atlantic Ocean Offshore Intake
 - 1D Card Sound Canal Intake
 - 1E Barge Slip Intake
 - 1F Deepened Canal System (Card Sound Canal and Barge Slip, not cooling canals)
- 2) Groundwater Sources
 - 2A Floridan Aquifer
 - 2B Biscayne Aquifer
 - 2C Boulder Zone
- 3) Reclaimed Water
- 4) Onsite Surface Water
 - 4A Cooling Canals/Industrial Wastewater Facility
 - 4B Deepened Cooling Canal System
- 5) Offsite Surface Water Reservoirs
 - 5A Comprehensive Everglades Restoration Plan (CERP) Joint Venture Alternative O
 - 5B Private Property Reservoir
- 6) Radial Collector Wells

The Floridan Aquifer alternative (Alternative 2A) considered a withdrawal from the brackish water zones of the Floridan Aquifer (i.e., the Upper Floridan Aquifer). The Biscayne Aquifer alternative (Alternative 2B) considered a withdrawal from the freshwater zone of the Biscayne Aquifer. The Radial Collector Well alternative (Alternative 6) considered a withdrawal from the saltwater zone of the Biscayne Aquifer.

During this phase, FPL also coordinated with the South Florida Water Management District (SFWMD) and hosted an interagency Compatibility Working Group (CWG) to consider specific issues related to the Units 6 & 7 Project. The group included participants from the Everglades National Park, Biscayne National Park, Miami-Dade County, South Florida Water Management District, Florida Department of Environmental Protection, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service and FPL. The CWG provided a consultative forum as the study progressed. This phase of the water alternatives study was documented in a report entitled *Analysis of Baseline Water Source* (HDR, December 20, 2007).

For the second phase of the water alternatives study, the Floridan Aquifer Alternative was replaced by two alternatives, the Upper Floridan Aquifer (brackish water source) and the Lower Floridan Aquifer (saltwater aquifer other than the Boulder Zone). For this phase, each of the 16 alternatives was evaluated against seven technical and eight environmental screening criteria, as listed below:

Technical Criteria

1. Water Availability
2. Volume of Water Required
3. Reliability of the Water Source
4. Water Quality
5. Water Use Permitting Feasibility
6. Navigation Impacts
7. Security

Environmental Criteria:

1. Biscayne Bay Construction Footprint Impacts
2. Biscayne Bay Habitat Impacts
3. Card Sound Construction Footprint Impacts
4. Card Sound Habitat Impacts
5. Everglades Construction Footprint Impacts
6. Everglades Habitat Impacts
7. Potential CERP Synergy
8. Environmental Permitting Feasibility

The alternatives were scored for each criterion using a numeric grade from zero (no impact) to 3 (most impact). All criteria were given the same weight. The total screening scores ranged from 13 to 31. Given the limited detail included in the screening criteria at this stage, it was recognized that the absolute ranking of the alternatives at this stage was not definitive. Therefore, the five alternatives with the lowest scores (i.e., least impact) were selected for further evaluation (the total score for each alternative is shown in parentheses):

1. Reclaimed Water (13)
2. Boulder Zone (14)
3. Lower Floridan Aquifer (16)
4. Radial Collector Well System (17)
5. Card Sound Canal Intake (18)

The Upper Floridan Aquifer (score = 20) and the Atlantic Ocean Offshore Intake (score = 22) were considered marginal. The Upper Floridan Aquifer alternative was not included for further evaluation because based on the *Lower East Coast Regional Water Supply Plan* (SFWMD, May 2000) water demand in the Lower East Coast is expected to increase dramatically in the future. Consequently, this alternative could conflict with the anticipated future demand. The *2005-2006 Lower East Coast Water Supply Plan Update* (SFWMD, 2005-2006) shows similar population and demand trends for Miami-Dade County. The Atlantic Ocean Offshore Intake also was not carried forward for the following reasons: security, construction impacts, navigation impacts and environmental permitting feasibility. While costs were not specifically considered at this phase of the process, a preliminary cost analysis indicated that this alternative would also have been cost prohibitive. While the Lower Floridan Aquifer alternative was one of the five alternatives with a low score based on the screening criteria (score 16), this alternative was recombined with the Boulder Zone alternative at the end of this phase of the study because of limited information on this zone. This phase of the water alternatives study was documented in two reports entitled *Task 1 Initial Water Source Alternative Screening* (HDR, March 13, 2008) and *Task 2 and 3 Water Source Alternative Characterization and Scope* (HDR, March 2008).

The third phase of the water supply alternatives study allowed a more detailed look at each of the five retained alternatives. In the third phase of the study, conceptual engineering issues of feasibility, reliability, environmental impact, risk and cost were addressed and the designs were addressed. While all five alternatives were feasible, the Boulder Zone, the Lower Floridan and the Card Sound Canal Intake alternatives had the greatest cost, risk and/or uncertainty. Consequently, these technologies ultimately did not rank as high as the reclaimed water and radial collector wells alternatives. Reclaimed water is technically and economically feasible and environmentally beneficial, provided a reliable alternative water source is available. Therefore, a water supply plan that included a primary and secondary supply was developed. Radial collector wells can provide a reliable secondary water source with minimal environmental impact. This phase of the water alternatives study was documented in a report entitled *Conceptual Engineering of Cooling Water Supply and Disposal For Turkey Point Units 6 & 7* (HDR, June 30, 2008).

In the fourth phase of the water supply alternatives study, the focus was on development of the reclaimed water alternative, including the pipeline and treatment systems, and on development of the radial collector well conceptual design. Activities during this phase of the water alternatives study have been documented in a report entitled *Cooling Water Supply and Disposal Conceptual Design Report* (HDR, March 2009).

MDWASD issued the most recent Reuse Feasibility Update in April 2007. Since that time, MDWASD has added consideration of a new western wastewater treatment facility and several events have influenced the planning process. On November 15, 2007, the SFWMD addressed reuse of reclaimed water in the water use permit for the Miami-Dade consolidated public water supply. Condition 39 of this permit requires the MDWASD to implement 170 MGD of reuse projects. Condition 41 requires the MDWASD work with FPL to provide up to 70 MGD of reclaimed water for the proposed nuclear generating units and 14 MGD for the gas powered Unit 5. In 2008, the Florida legislature passed legislation that eliminates the option for coastal communities to use ocean outfalls as a disposal mechanism for wastewater treatment plant effluent. The legislation requires that at least 60 percent of the current ocean outfall flow be converted to reuse. While reclaimed water is not currently being used at the Turkey Point facility, FPL committed to use reclaimed water to the maximum extent possible as the primary source of cooling water for Units 6 & 7. FPL has determined that it can use up to 90 MGD of reclaimed water that meets regulatory requirements for use and FPL's operational standards. Consequently, for more than a year, MDWASD and FPL have been working to develop a Joint Participation Agreement (JPA), which defines responsibilities and a schedule of implementation activities. On January 22, 2009, the Miami-Dade County Commission approved resolution #R-72-09 authorizing the Mayor to negotiate a water services agreement and contract for providing reclaimed water to FPL's Turkey Point facility.

Therefore, the primary source of cooling water makeup for Units 6 & 7 will be reclaimed water from the MDWASD, with potable water also from MDWASD. The Project will include an off-site FPL reclaimed water treatment facility (see SCA Chapter 1, Figure 1.4-1) and associated pipelines. This reclaimed water use is a beneficial and cost-effective means of increasing the use of reclaimed water in Miami-Dade

County and helps the County meet its reclaimed water compliance requirements. In the absence of reuse opportunities, this treated domestic wastewater would likely continue to be discharged to the ocean or to deep injection wells. Miami-Dade County is required to eliminate ocean outfalls and increase the amount of water that is reclaimed for environmental benefit and other beneficial uses. Units 6 & 7 will use reclaimed water 24 hrs per day, 365 days per year when operating and water in sufficient quality and quantity is available. This use of reclaimed wastewater will enable the County to meet approximately half of its wastewater reuse goals and will provide environmental benefits by reducing the volume of wastewater discharged by the County.

Following its use in Units 6 & 7, a significantly reduced volume of wastewater will be discharged via on-site deep injection wells. When reclaimed water is not available in sufficient quantity and quality, the secondary makeup water source will come from radial collector wells, substratum collectors of saltwater that will recharge from below Biscayne Bay.

4.0 Water Conservation Plan

The most significant water conservation measure for the Turkey Point Units 6 & 7 Project is the use of reclaimed water, as discussed above. The next most significant conservation measure is the use of close-cycle cooling towers. While the most thermodynamically efficient cooling process for the steam cycle would be a once-through cooling system, this type of cooling system has a very high water withdrawal requirement that could result in large impacts to aquatic organisms from impingement and entrainment. Thus, when compared to a once through cooling system, the cooling towers proposed for Units 6 & 7 significantly reduce the amount of water that must be withdrawn from the environment, while maintaining acceptable thermodynamic efficiency. The cooling towers will be designed and constructed to minimize unnecessary loss of water.

Stormwater from the Site will be released to the industrial wastewater facility and reused for cooling of existing Units 1-4. Wastewater effluents that cannot be reused will be discharged through deep injection wells permitted by the Florida Department of Environmental Protection (FDEP) underground injection control (UIC) program.

All systems that involve the use of water will be designed and commissioned to minimize water loss. This will include an in-service leak test, inspection, or hydro-test to ensure the system is leak tight. After commissioning, procedures will be in place to ensure that the systems are inspected on a regular basis and that a repair program is in place to repair any leaks quickly.

Other features in the plant design will include, when practical:

- Automatic shutoff valves,
- Flow restrictors,
- Low-volume sanitary facilities, and
- Low-volume landscape design.

The Project will implement an awareness program for both construction and operations employees on water conservation for the facility. The awareness program will educate employees on water conservation methods, techniques, and requirements of in-place construction and operation procedures. Procedures for conservation will be developed before commencement of construction and will be included in the Environmental Control Plan. Procedures for water conservation during plant operation will be developed prior to commissioning the generating units. Procedures will be reviewed on an annual basis and updated as necessary.

The design of the overall Turkey Point Unit 6 & 7 Project is not yet final. FPL will continue to pursue opportunities to increase the efficiency of its water use by identifying and pursuing opportunities to cost-effectively use the lowest quality water available for each use and reuse of waste streams where possible. For example, if additional treated reclaimed water is available, it will be considered for use in place of potable or higher quality process water.

5.0 Conclusion

The preferred (primary) source of cooling water for Units 6 & 7 is reclaimed water. The alternative (secondary) source is the radial collector wells that will withdraw saltwater, recharged from the marine environment.

The only feasible source at this time for process and potable water is the potable supply from Miami-Dade County.