FPL.

L-2012-283
10 CFR 52.3

July 13, 2012

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Re: Florida Power & Light Company
Proposed Turkey Point Units 6 and 7
Docket Nos. 52-040 and 52-041
Response to NRC Request for Additional Information Letter No. 063 (eRAI 5695)
Related to SRP Section 11.02 – Liquid Waste Management System

References:

1. NRC Letter to FPL dated May 21, 2012, Request for Additional Information Letter No. 063 Related to SRP Section 11.02, Liquid Waste Management System, for the Turkey Point Nuclear Plant Units 6 and 7 Combined License Application

2. FPL Letter L-2012-278 to NRC dated July 2, 2012, Schedule for Response to NRC Request for Additional Information Letter No. 063 (eRAI 5695) Related to SRP Section 11.02 – Liquid Waste Management System

Florida Power & Light Company (FPL) provides, as an attachment to this letter, its response to the Nuclear Regulatory Commission's (NRC) Request for Additional Information (RAI) 11.02-1 to 11.02-4 provided in Reference 1. The schedule for this response was provided in Reference 2. The attachment identifies changes that will be made in a future revision of the Turkey Point Units 6 and 7 Combined License Application (if applicable).

If you have any questions, or need additional information, please contact me at 561-691-7490.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on July 13, 2012.

Sincerely,

William Maher
Senior Licensing Director – New Nuclear Projects

D097
NRO

WDM/RFO

Attachment 1: FPL Response to NRC RAI No. 11.02-1 (eRAI 5695)
Attachment 2: FPL Response to NRC RAI No. 11.02-2 (eRAI 5695)
Attachment 3: FPL Response to NRC RAI No. 11.02-3 (eRAI 5695)
Attachment 4: FPL Response to NRC RAI No. 11.02-4 (eRAI 5695)

cc:
PTN 6 & 7 Project Manager, AP1000 Projects Branch 1, USNRC DNRL/NRO
Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant Units 3 & 4

NRC RAI Letter No. 063 Dated May 21, 2012

SRP Section: 11.02 – Liquid Waste Management System

Question from Radiation Protection and Accident Consequence Branch (RPAC)

NRC RAI Number: EIS 11.02-1 (eRAI 5695)

Section 11.2 of the Turkey Point FSAR describes a proposed method for disposal of radioactive liquid effluents by deep well injection. Deep well injection represents a disposal method that contains uncertainties and unevaluated sensitivity in the modeling data for which the NRC staff do not have sufficient information to perform confirmatory analysis. It is the understanding of the NRC staff that pursuant to 10 CFR 20.2007, "Compliance with environmental and health protection regulations," the applicant must also obtain approval from the Florida state agency responsible for underground injection control (UIC) permits for a Class I well. This process is not part of the NRC staff's safety evaluation and no information is requested regarding that permit process.

Rather, FSAR Section 11.2 does not provide sufficient detail for the staff to verify the methodologies and analytical limitations and assumptions used by the applicant to determine the projected dose from liquid effluents, and/or whether the pathway and hypothetical future intrusion scenario analysis may be excluded from consideration in dose estimates. After additional review and discussion, it is the NRC staff's understanding that due to the complexity and information limitations on transport, several conservative assumptions and simplified modeling constraints were used, in order to clearly bound credible estimates of dose and environmental behavior of the effluents. Therefore, please provide the following information:

With respect to deep well injection into the Boulder Zone referred to in FSAR Section 11.2.3.5, please provide sufficient information on effluent release, dilution, transport, dispersion, uses, and other relevant factors, to support estimates of radiation dose from liquid effluents, including whether there are any projected liquid effluents that will not be discharged by this method.

With respect to the deep well injection systems, structures, and components as discussed in FSAR Sections 11.2.1.2.5.1 (PTN SUP 11.2-1), 11.2.3.5 PTN COL 11.2-2 and 11.5-3), an overview of the proposed deep well injection process, consistent with FSAR Section 9.2.6.2.1 as referenced in FSAR Section 11.2.3.5, sufficient for the staff to evaluate site-specific functions that are outside the scope of the DCD.

FPL RESPONSE:

The travel time to the receptor (13.7 years), as presented in FSAR Section 11.2.3.5, was calculated using a form of the continuity equation, given as follows:

$$Qt_0 = \pi R^2 b n_e \quad (1)$$

where:

Q = well injection rate, ft^3/year
R = radius of injectate front, feet
b = aquifer thickness, feet
n_e = effective porosity
t_o = time required for the injectate front to travel to the receptor

An injection rate (Q) of approximately 12,500 gallons per minute (gpm) using 100% reclaimed water (8.76E08 ft^3/yr) was selected as the bounding discharge flow (for two units), from ER Table 3.3-1. (Note: Although the injection rate for a 100% saltwater source is greater at 58,175 gpm [ER Table 3.3-2], using the smaller flow is conservative as it yields higher radionuclide concentrations, which are below 10 CFR20, Appendix B, Table 2 regulatory limits at the point of discharge.) A radial distance (R) of 9776 feet was used to represent the nearest receptor on land not owned by FPL that could potentially be used for a water supply well from the Boulder Zone. A Boulder Zone aquifer thickness (b) of 200 feet was assumed. This is a conservative assumption since (EPA 2003) has reported a typical Boulder Zone Aquifer thickness of 500 feet. This assumption also considers the potential presence of a lower density layer of water (e.g. reclaimed water), 200 feet in thickness, which could eventually develop in the Boulder Zone. The result is a lower injectate front travel time, based on a lower assumed aquifer thickness. Use of the saltwater injectate, which is closer in density to the Boulder Zone water, would likely mix more readily with the Boulder Zone water and therefore, a larger water layer thickness would be more appropriate for analysis, resulting in a larger injectate front travel time. Finally, an effective porosity (n_e) of 0.2 was assumed (EPA 2003).

Equation (1) was solved for travel time (t_o), resulting in a value of 13.7 years for the injectate front to reach the first receptor on non-FPL-owned land. This travel time is considered bounding, since the receptor location is the closest feasible location for which a water supply well could be used. This analysis did not consider dispersion, diffusion, dilution, radionuclide transport retardation, or density-dependent mixing processes. The receptor dose was then calculated using this travel time, isotopic activity releases from DCD Table 11.2-7, and other assumptions, as stated in FSAR Section 11.2.3.5, using the LADTAP II computer program. As depicted in ER Figure 3.3-1, all plant effluents will be discharged to the Boulder Zone using deep well injection. Boulder Zone use is addressed in the response to RAI 11.02-2.

A summary of the deep well injection process, including a conceptual design of the below and above grade systems, monitor wells, operation, and monitoring requirements is discussed in the paragraphs below.

The injection well system is proposed to include twelve deep injection wells. The number of wells that will be in service at any one time to provide the required disposal capacity is dependent on the make up cooling water source: three wells when using reclaimed water and ten wells when using radial collector well water (with both units operating). The valve on the wellhead of wells in service will be open; the valve on the wellhead of wells not being utilized for disposal will be shut. Below grade components of the deep injection wells will include cement, five steel well casing strings of varying diameters (64-inch, 54-inch, 44-inch, 34-inch, and 24-inch). A nominal 18-inch diameter fiberglass reinforced plastic (FRP) injection tubing will be installed inside the 24-inch casing. The 18-inch FRP will be used to inject fluid into the Boulder Zone. The base of the injection tubing will be connected to the 24-inch diameter injection casing using a positive seal packer. The annulus between the injection casing and injection tubing will contain water with a corrosion inhibitor and will be maintained at a pressurized condition.

A dual-zone monitor well (DZMW) will be associated with each pair of deep injection wells. The DZMWs will monitor two separate intervals to allow for the detection of possible upward migration of injected fluids. Below grade components of the DZMWs include well casings, cement, a submersible sampling pump and submersible pressure transducer. The DZMW conceptual design of the well casings diameters are 44-inch, 34-inch 16-inch, and a 6⅝-inch. Two small pumps and transducers (one submersible and one mounted above grade) will be placed in the well to sample the upper and lower monitor zones and monitor pressure. Water samples from both monitor zones of the DZMW will be collected and analyzed in accordance with the Florida Department of Environmental Protection (FDEP) Class I injection well permit.

Piping from the blowdown sump dilution connection point is routed to the deep injection wells and distributed in two branches; one branch is oriented in a north-south direction and located to the east of Unit 6. The second branch is oriented in the east-west direction and located to the south of Units 6 & 7, as shown on FSAR Figure 1.1-201.

Water to be injected will be pumped from a central pump station to the deep injection wells via a disposal pipeline. Fluid will travel through the wellhead piping, down the injection tubing, and into the Boulder Zone. This injectate piping to each deep injection well isolation valve is single-walled, partially buried, and constructed of material suitable for the range of injectate composition, flow rates, and pressures, as well as environmental factors. The injectate piping contains manifolds, valves, and controls necessary to supply any appropriate combination of the deep injection wells. The injectate piping also includes appurtenances, such as vacuum breakers, vent lines, and access ways, as necessary, for proper operation and maintenance of the piping. Injection rate, wellhead pressure, and annulus pressure will be monitored and recorded continuously. This data will be transmitted to a data collection center.

The guard pipe-enclosed radwaste discharge piping from the Radwaste Building connects to the blowdown sump discharge piping downstream of the blowdown sump pumps. Dilution of the liquid radwaste is initiated as the radwaste enters the blowdown sump discharge stream. The content of the blowdown sump is a combination of wastestreams largely comprised of reclaimed water or seawater from circulating water system blowdown during plant operation or from the alternate dilution flow paths when circulating water system blowdown is not sufficient or available for dilution.

Injection well injection rate, injection pressure, annular pressure, and injection fluid analytical results for each of the injection wells will be provided to the FDEP in a Monthly Operating

Report (MOR). The MOR will also include water level data and water sample analytical results for both zones of the DZMWs.

This response is PLANT SPECIFIC.

References:

U.S. Environmental Protection Agency (EPA) 2003. *Relative Risk Assessment of Management Options for Treated Wastewater in South Florida.* Office of Water, EPA 816-R-03-010, pp. 4-9. April. 2003.

ASSOCIATED COLA REVISIONS:

FSAR Section 11.2.3.5 will be revised in a future revision as follows:

In order to determine the decay time for the injectate front to reach Receptor 3, an analysis was performed that considered the injection rate, aquifer thickness, and porosity of the Boulder Zone. **This decay, or travel time, was calculated using a form of the continuity equation, given as follows:**

$$Qt_0 = \pi R^2 b n_e \qquad \textbf{(1)}$$

where:

Q = well injection rate, ft^3/year
R = radius of injectate front, feet
b = aquifer thickness, feet
n_e = effective porosity
t_o = time required for the injectate front to travel to the receptor

An injection rate (Q) of approximately 12,500 gallons per minute (gpm) using 100% reclaimed water (8.76E08 ft^3/yr) was selected as the bounding discharge flow (for two units), from ER Table 3.3-1. (Note: Although the injection rate for a 100% saltwater source is greater at 58,175 gpm [ER Table 3.3-2], using the smaller flow is conservative as it yields higher radionuclide concentrations, which are below 10 CFR20, Appendix B, Table 2 regulatory limits at the point of discharge.) A radial distance (R) of 9776 feet was used, as previously discussed. A Boulder Zone aquifer thickness (b) of 200 feet was assumed. This is a conservative assumption since *EPA* (Reference 201) has reported a typical Boulder Zone Aquifer thickness of 500 feet. This assumption also considers the potential presence of a lower density layer of water (e.g. reclaimed water), 200 feet in thickness, which could eventually develop in the Boulder Zone. The result is a lower injectate front travel time, based on a lower assumed aquifer thickness. Use of the saltwater injectate, which is closer in density to the Boulder Zone water, would likely mix more readily with the Boulder Zone water and therefore, a larger water layer thickness would be more appropriate for analysis, resulting in a larger injectate front

travel time. Finally, an effective porosity of 0.2 was assumed (Reference 201). The resulting time required for the injectate to reach Receptor 3 is approximately 13.7 years. This horizontal travel time through the Boulder Zone is used in the dose calculation described below.

A new section, FSAR 11.2.6, will be added in a future revision as follows:

11.2.6 REFERENCES

201. U.S. Environmental Protection Agency (EPA) 2003. *Relative Risk Assessment of Management Options for Treated Wastewater in South Florida*. Office of Water, EPA 816-R-03-010, pp. 4-9. April. 2003.

ASSOCIATED ENCLOSURES:

None

NRC RAI Letter No. 063 Dated May 21, 2012

SRP Section: 11.02 – Liquid Waste Management System

Question from Radiation Protection and Accident Consequence Branch (RPAC)

NRC RAI Number: EIS 11.02-2 (eRAI 5695)

FSAR Section 11.2.3.5 and PTN COL 11.2-2 refer to the hypothetical intrusion scenario being an off-normal operation for which a cost benefit analysis is not needed. The information in the FSAR is not sufficient for the NRC staff to confirm the validity of the assumption. Pursuant to 10 CFR 50 Appendix I, Section II.D, a cost benefit analysis would be appropriate, as a minimum indicating assumptions as to bounding values on dose and effluent fate. The licensee will not have control over the environment or the behavior of the public that might affect access to the effluent. Therefore, please provide additional information on bounding cost/benefit, in particular as to whether and/or why deviations of individual habits from the average are or are not reasonable under 10 CFR 50 Appendix I, Section III.A.2, i.e., accessing the Boulder Zone for extraction of liquids.

FPL RESPONSE:

A detailed review of the South Florida Water Management DBHYDRO database for current water use permits indicates there are no known users of the Boulder Zone for water supply within the South Florida area. The only current and past use of the Boulder Zone in South Florida is for disposal of municipal and industrial wastewater and brines associated with the oil and gas industry via deep well injection.

The Boulder Zone is not considered practical for water supply use due to several reasons. Most notably, it contains water with salinity close to that of seawater. There are much higher quality ground water supplies available at a much lower capital and operational costs to municipalities, industries, and individuals. The Biscayne Aquifer is an extremely productive, freshwater, water-table aquifer extensively used for water supply in southeastern Miami-Dade County. Water from the Biscayne Aquifer typically requires minimal treatment for use as inexpensive potable water. Some municipalities use the Upper Floridan Aquifer as an alternate water supply (Reese and Richardson, 2008). In southeast Florida, water from the Upper Floridan Aquifer is brackish and available in large supply. Due to the brackish nature of water produced from the Upper Floridan Aquifer, the water must undergo membrane softening or reverse-osmosis treatment before being used (Reese and Richardson, 2008). Treatment of Boulder Zone water would be considerably more expensive than desalting the less saline brackish water of the Upper Floridan Aquifer. Furthermore, seawater salinity water could be obtained along the coast at a much lesser cost either directly from Biscayne Bay or from the surficial aquifer seawards of the saline-water interface.

Based on the availability of a more productive freshwater aquifer (Biscayne Aquifer) or the availability of a brackish aquifer (Upper Floridan Aquifer) that is located above the Boulder Zone that would require pre-treatment similar to water obtained from the Boulder Zone, use of the Boulder Zone for potable water supply is not a reasonable scenario. As indicated in 10 CFR 50, Appendix I, Section II.D, a cost- benefit analysis is required to determine whether radwaste system augments can yield reductions in the 50-mile population dose at a cost of less than $1000 per man-rem. Based on the above discussion, use of Boulder Zone water for potable water use is not a reasonable scenario. The only potential exposure pathway discussed for liquid effluents is a nearby receptor drilling into the Boulder Zone to obtain potable water. This off-normal, conceptual scenario applies to an individual, not the population. Therefore, a cost benefit analysis was not performed.

This response is PLANT SPECIFIC.

References:

Reese, R.S., and Emily Richardson, 2008. *Synthesis of the Hydrogeologic Framework of the Floridan Aquifer System and Delineation of a Major Avon Park Permeable Zone in Central and Southern Florida*: U.S. Geological Survey Scientific Investigations Report 2007-5207.

ASSOCIATED COLA REVISIONS:

FSAR Section 11.2.3.5 will be revised in a future revision as follows:

The resulting maximum doses per unit are 2.5 mrem to the total body, 2.4 mrem to the thyroid, and 3.1 mrem to the liver of a child. Even though these doses are not due to normal operations, they conform to the 10 CFR 50, Appendix I guidelines of 3 mrem total body and 10 mrem organ. **As indicated in 10 CFR 50, Appendix I, Section II.D, a cost- benefit analysis is required to determine whether radwaste system augments can yield reductions in the 50-mile population dose at a cost of less than $1000 per man-rem. Based on the above discussion, use of Boulder Zone water for potable water use is not a reasonable scenario. The only potential exposure pathway discussed for liquid effluents is a nearby receptor drilling into the Boulder Zone to obtain potable water. This off-normal, conceptual scenario applies to an individual, not the population. Therefore, a cost benefit analysis was not performed**. ~~The above doses were evaluated for off-normal events. Therefore, consistent with RG 1.110, no cost benefit analysis was performed.~~

ASSOCIATED ENCLOSURES:

None

NRC RAI Letter No. 063 Dated May 21, 2012

SRP Section: 11.02 – Liquid Waste Management System

Question from Radiation Protection and Accident Consequence Branch (RPAC)

NRC RAI Number: EIS 11.02-3 (eRAI 5695)

In Final Safety Analysis Report (FSAR) Section 11.2.3.5, PTN COL 11.2-2, the applicant stated that treated liquid radioactive waste from Unit 6 and 7 operation is to be discharged to the Boulder Zone via deep injection wells. In Section 2.3.2.2.2 of the applicant's Environmental Report (ER), the applicant stated that "based on a review of data from other deep injection wells in southeast Florida, it is estimated that each injection well would have a maximum allowed injection capacity of 18.6 million gallons per day [GPD] at a peak hourly flow." Given the high total injection rate and the potential in the event of well malfunction for upward or interrupted flow while transiting nearer-surface aquifers from which water consumption may occur, and at least one report of which the NRC staff is aware that addresses what appears to be a similar (see footnote 1) occurrence, the NRC staff is unable to whether the applicant meets the acceptance criteria in SRP 11.2 and complies with the requirements of 10 CFR 20.2002. Therefore, please provide additional information on the bounding volumes and relative volumetric flow rates, sufficient to support the bounding conclusion that the injectate will proceed to the Boulder Zone and not other aquifers.

[1] Dausman, Alyssa M., Langevin, C., Sukop, M.C., and Walsh, V., Saltwater/Freshwater Interface Movement in Response to Deep-Well Injection in a Coastal Aquifer, 20th Salt Water Intrusion Meeting, June, 2008, Naples, Florida.

FPL RESPONSE:

The conclusion that the injectate will proceed to the Boulder Zone and not other aquifers is discussed using supporting data and analysis in the following paragraphs. The data used include actual data collected from the site during construction of a 3,230-foot deep exploratory well (e.g., geophysical logs, rock core data, and packer testing data). Additionally, injection pressure versus overburden pressure analysis is presented to demonstrate the wells can be safely operated without potential to damage the overlying confining unit. As a result of the supporting data and analysis presented in this response, an analysis regarding bounding volumes and relative volumetric flow rates is not required.

An exploratory well was completed at the Turkey Point site in 2012 to evaluate the geology and hydrogeology of the site, to confirm the presence of the regional middle confining unit of the Floridan Aquifer System and the underlying Boulder Zone at the site, and to determine the depth of base of the Underground Source of Drinking Water (USDW).

Data collected during construction of Exploratory Well EW-1 demonstrate the presence of the top of the Boulder Zone at a depth of approximately 3,035 feet and the base of the USDW at a depth of approximately 1,450 feet. Of the approximately 1,585 feet that separate the Boulder Zone from the base of the USDW, over 900 feet of effective confining strata is present. These relatively low-permeability strata will prevent fluids injected into the Boulder Zone from migrating into a USDW. Data collected to demonstrate the presence of the confining strata are discussed below.

Field testing performed on the pilot hole through the confining strata and into the Boulder Zone included borehole compensated sonic, caliper, dual-induction, gamma ray, flowmeter, fluid specific conductance, spontaneous potential, temperature and video logs. Flowmeter, fluid conductivity and temperature logs were performed under static and dynamic conditions. The remaining logs were performed under static conditions. Review of the flowmeter, fluid conductivity and temperature logs suggests there are no significant water producing zones between 1,980 and 2,915 feet below pad level (bpl). The relatively stable and short acoustic travel time suggests the lithology of this interval has a relatively low porosity.

The borehole geophysical data and well cuttings indicate that almost all the interval between 1,980 and 2,915 feet bpl consists of relatively soft carbonate rock. The relatively stable and short acoustic travel time suggests the lithology of this interval has a relatively low porosity and is not significantly fractured. Increases in vertical hydraulic conductivity due to fracturing are believed to be the cause of the rapid vertical migration of injected water in some South Florida injection well systems (Maliva et al., 2007). The above interpretation of the geophysical logs is that the interval from 1,980 to 2,915 feet bpl is confining in nature and makes up the primary confinement at the site.

Drilling of the EW-1 pilot hole was interrupted to allow collection of ten core samples. The ten core samples were collected between the depths of 1,721.5 feet and 2,679 feet. Each core was described to obtain information regarding the confining characteristics of the cored interval. Portions of the cores were sent to a laboratory for vertical and horizontal hydraulic conductivity, specific gravity, porosity, unconfined compressive strength, and Young's Modulus. Review of the core laboratory data indicates the vertical hydraulic conductivity ranged from 1.6 E-06 cm/second to 5.4 E-04 cm/second, indicating low hydraulic conductivity strata present at the site at the cored intervals are confining in nature.

Packer testing was conducted on nineteen intervals between 1,102 and 3,232 feet bpl to determine water quality and confining characteristics of the tested intervals. Pumping rate and water level drawdown results were used to determine the specific capacity of the test interval, which provides information related to the average horizontal hydraulic conductivity of the tested interval. Packer testing data provide a conservative approach to confinement analysis since horizontal hydraulic conductivity is often an order of magnitude or greater than the average vertical hydraulic conductivity of the tested interval. The horizontal hydraulic conductivity is typically much greater than the vertical hydraulic conductivity due to the nature in which sediments orient with their long axis in the horizontal plane rather than standing up vertically. The predominance of horizontally oriented sediments that ultimately become compressed and lithified into rock created this difference in horizontal and vertical hydraulic conductivity. Table 1 provides a summary of the packer tests pumping rate and water level data for each of the ten packer tests performed during construction of EW-1.

Table 1 – EW-1 Packer Test Summary

Test #	Test Interval (ft. bpl)	Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/foot)
1	1,505 – 1,535	76	31.3	2.43
2	1,400 – 1,430	77	40.6	1.9
3	1,225 – 1,285	78	33.2	2.35
4	1,102 – 1,162	16	161	0.1
5	1,930 – 1,952	2	60	0.03
6	2,989 – 3,011	150 (estimated)	Moved packers up 5 feet due to test interval productivity during conditioning	
	2,984 – 3,006	150 (estimated)	Terminated due to test interval productivity during conditioning	
7	3,020 - 3,232	78	1.6	49
8	1,970 - 1,992	0.5	145.8	0.003
9	2,058 - 2,080	4.9	98	0.05
10	2,183 – 2,205	Terminated due to packers not isolating the test interval or too productive.		
11	2,552 – 2,574	Terminated due to packers not isolating the test interval or too productive.		
12	2,634 – 2,656	Terminated due to packers not isolating the test interval or too productive		
13	2,844 – 2,866	Terminated due to packers not isolating the test interval or too productive.		
14	2,480 – 2,502	Terminated due to packers not isolating the test interval or too productive.		
15	2,552 – 2,574	Terminated due to packers not isolating the test interval or too productive		
16	2,694 – 2,716	Terminated due to packers not isolating the test interval or too productive.		
17	2,220 - 2,242	3.9	71	0.05
18	2,400 – 2,422	Terminated due to packers not isolating the test interval or too productive.		
19	2,478 – 2,500	21.7	91	0.24

Water quality samples were used assist in the identification of the base of the USDW. Straddle packer test water sample data identified the base of the USDW between the depths of 1,430 and 1,505 feet. (The base of the USDW was identified at a depth of approximately 1,450 feet using a separate source of data - geophysical logs.)

Each of the five straddle packer test performed between the depths of 1,930 feet and 2,500 feet demonstrated a low specific capacity ranging from 0.003 gallons per minute per foot to 0.24 gallons per minute per foot. These low specific capacities are characteristic of confining strata. Packer test results are indicative of the average horizontal hydraulic conductivity of the tested strata, which is often an order of magnitude or greater than the average vertical hydraulic conductivity (Freeze and Cherry, 1979), the key parameter for confinement analyses. Packer test data are thus highly conservative for confinement analysis.

The results of the packer tests performed on the intervals above a depth of 1,930 feet bpl are not indicative of confining conditions, with the exception of the test interval from 1,102 to 1,162 feet bpl. The results of the packer test performed on the interval from 3,020 to 3,232 bpl indicate highly transmissive conditions, which are evidence that this test interval is located within the Boulder Zone.

Testing performed during construction of deep injection wells in South Florida demonstrate that the confining interval overlying the Boulder Zone is a regional feature. Table 2 provides a summary of packer testing data for a nearby deep injection well to the Turkey Point site - the Florida Aqueduct Authority J. Robert Dean Water Treatment Plant deep injection well. The distance between the J. Robert Dean Water Treatment Plant deep injection well and the Turkey Point Units 6 & 7 site is approximately 11 miles. The low specific capacities observed, which are lower than that observed at Turkey Point, confirm the presence of a confining layer above the Boulder Zone.

Table 2 - J. Robert Dean WTP Straddle Packer Test Performance Data Summary[1]

Test #	Test Interval (ft. bgs)	Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/foot)
IW-1-4	1,528 – 1,550	71	143.5	0.022
IW-1-1	1,875 – 1,950	85	94.3	0.012
IW-1-11	2,084 – 2,104	26	34.8	0.042
IW-1-10	2,196 – 2,214	21	119	0.01
IW-1-9	2,276 – 2,294	10.5	130.9	0.004
IW-1-8	2,636 – 2,654	27	75.5	0.02

[1] Source: Boyle Engineering, 2008

Finally, potential damage to the injection zone and confining unit (formation fracturing) can occur when formation injection pressures surpass the mechanical strength of the formation. Using the methodology developed by *Hubbert and Willis* (1972), at a depth of 2,985 feet bgs, using the calculated fracture initiation gradient of 0.64 pounds per square inch/foot (psi/ft.), the calculated minimum bottom-hole pressure that may create hydraulic fracturing is 1,910 psi.

Wellhead injection pressures for deep injection wells completed into the Boulder Zone in South Florida typically ranges from approximately 25 to 60 psi. The actual increase in bottom hole pressure is typically only a small fraction of the measured wellhead pressure, which is due to mainly frictional losses within the casing during injection and the buoyancy (due to a lower salinity) of the injected water. This pressure is considerably less than the previously calculated minimum fracture initiation pressure of 1,910 psi.

Based on the field and laboratory data presented, which was obtained from the site deep injection exploratory well, there exists over an 900-foot thick confining layer above the Boulder Zone. This confining layer was found to have low hydraulic conductivity, based on laboratory and in-situ packer testing. Wellhead injection pressure analysis indicated that overburden pressure will not be exceeded by the injection well pressure; therefore the potential for hydraulic fracturing is minimal. Deep injection well systems throughout Southeast Florida rely on the regionally extensive middle confining unit of the Floridan Aquifer interval that was observed at the Turkey Point Units 6 & 7 site during construction of EW-1. The middle confining unit of the Floridan Aquifer is a regional feature, is present throughout Southeast Florida and has been demonstrated to be present at each of the deep injection well sites in Miami-Dade, Broward, and Palm Beach counties. In addition, the Boulder Zone has a high capacity for injectate, based on its effective porosity and thickness. Therefore, it is reasonable to assume that the potential for upward migration of injectate is small, and if upward migration to drinking water aquifer were to occur, it would be below regulatory limits beyond the closest feasible receptor, as discussed in RAI 11.02-1.

The NRC referenced report discusses the impacts of upward fluid migration at a site that is known to have vertical fluid migration (i.e., well failure). The deep injection well system cited in the Dausman report was constructed over 25 years ago, when precautions during well construction to prevent the development of vertical conduits that could allow upward fluid migration were not taken. The pathway that has allowed the upward migration of injected fluids at the referenced site is suspected to be related the development of a double borehole during well construction. A double borehole can develop while reaming a pilot hole to a larger diameter in preparation for casing installation. Occasionally, the pathway that the reaming bit takes diverges from the pilot hole, resulting in two separate boreholes. One of the boreholes ultimately has casing installed inside it, while the other borehole remains open. If such a double borehole penetrates the confining unit at the site and has been drilled into the injection zone, a direct conduit for injected fluid to migrate upward has been created.

The deep injection wells at Turkey Point Units 6 & 7 will be constructed in a manner that eliminates the opportunity for the development of a double borehole through the confining unit. Pilot holes penetrating below a depth of 1,400 feet will undergo back-plugging with cement to eliminate the possibility of a double borehole scenario.

This response is PLANT SPECIFIC.

References:

Boyle Engineering, 2008. Re: Florida Key Aqueduct Authority – J. Robert Dean Water Treatment Facility Injection Well System Construction Permit; 62368-001-UC; IW-1 Final Casing Setting Depth Recommendation. October, 2008.

Freeze, R.A., and J.A. Cherry, 1979. Groundwater: Prentice-Hall, Englewood Cliffs, NJ, p. 34.

Hubbert, M.K., and D.G. Willis, 1972. *Mechanics of Hydraulic Fracturing*. Mem. Am. Assoc. Pet. Geol., 18. pp. 239-257.

Maliva, R.G., Goo, W., Messier, T.M., 2007, *Vertical Migration of Municipal Wastewater in Deep Injection Well Systems, South Florida, U.S.A.*: Hydrogeology Journal, v. 15, p. 1387-1396.

ASSOCIATED COLA REVISIONS:

No COLA changes have been identified as a result of this response.

ASSOCIATED ENCLOSURES:

None

NRC RAI Letter No. 063 Dated May 21, 2012

SRP Section: 11.02 – Liquid Waste Management System

Question from Radiation Protection and Accident Consequence Branch (RPAC)

NRC RAI Number: EIS 11.02-4 (eRAI 5695)

10 CFR 20.1301(e) delineates that 10 CFR Part 20 licensees subject to 40 CFR Part 190 environmental radiation standards shall also comply with 40 CFR Part 190, which is applicable to the entire fuel cycle. As the proposed Units 6 and 7 would be located near other fuel cycle facilities, 40 CFR Part 190 is applicable. The information provided in Final Safety Analysis Report (FSAR) Section 11.0, does not provide sufficient specificity as to 40 CFR Part 190 for the NRC staff to evaluate the entire fuel cycle for Units 6 and 7. Please provide information for comparison between the general environmental radiation standards in 40 CFR Part 190 and corresponding estimates of site environmental radiation dose, including relevant supporting bases and assumptions used in your analysis.

FPL RESPONSE:

In establishing the standards for normal operation, 40 CFR 190 specifies the regulatory acceptance criteria for doses to members of the public from all fuel cycle facilities on site. As there are no liquid effluent doses from the new units and any direct radiation at the site boundary is negligible for the AP1000, the only relevant pathway is gaseous effluent. Specifically, gaseous effluent doses from the new Units 6 and 7, as well as existing Units 3 and 4, are considered in arriving at the total doses from the site. To demonstrate compliance with 40 CFR 190, FSAR Subsection 11.3 will be revised as indicated below.

FSAR Subsection 11.3 will also be revised to reflect changes in the projected 50-mile population for 2090. Previously the projection was based on the 2000 population. The projection is now based on the 2010 population.

This response is PLANT SPECIFIC.

References:

None

ASSOCIATED COLA REVISIONS:

The last paragraph of FSAR Section 11.3.3.4.1 will be revised in a future revision as follows:

> Table 11.3-201 contains GASPAR II input data for dose rate calculations. Information regarding the locations for the nearest residence, meat animal, garden, and the site boundary is located in FSAR Section 2.3. Table 11.3-204 contains total organ dose rates based on age group. Table 11.3-205 contains total air doses at each special location.

Table 11.3-206 shows the total site doses from Units 6 & 7 as well as the two existing Units 3 & 4 are within the regulatory limits of 40 CFR Part 190.

FSAR Section 11.3.3.4.2 will be revised in a future revision as follows:

The estimated population dose within 81 kilometers (50 miles) is calculated as 4.7 person-rem total body and 8.7 person-rem thyroid per unit. Table 11.3-20~~6~~**7** contains the estimated population doses by nuclide group (noble gases, iodines, particulates, C-14, and H-3).

FSAR Section 11.3.3.4.4 will be revised in a future revision as follows:

As shown in Table 11.3-20~~6~~**7**, 2.4 of the 8.7 person-rem thyroid dose is due to noble gases, which will not be mitigated by the Steam Generator Flash Tank Vent to Main Condenser.

Table 11.3.206 will be revised in a future revision as follows:

Table 11.3-20~~6~~7
Estimated Population Doses per Unit

New Table 11.3.206 will be added in a future revision as follows:

Table 11.3-206
Comparison of Individual Doses with 40 CFR 190 Criteria

	Dose (mrem/yr)			
	Units 6 & 7[(a)]	Units 3 & 4[(b)]	Site Total	Limit
Total Body	7.8	0.0029	7.8	25
Thyroid	15	0.0059	15	75
Other Organ - Lung	8.4	0.0059	8.4	25

(a) Site boundary doses from a single new unit are doubled.
(b) Bounding site boundary doses from five years of annual effluent reports for the existing units; lung dose assumed to be same as thyroid dose.

ASSOCIATED ENCLOSURES:

None