LBP-17-05

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

E. Roy Hawkens, Chairman
Dr. Michael F. Kennedy
Dr. William C. Burnett

In the Matter of FLORIDA POWER & LIGHT COMPANY (Turkey Point Units 6 and 7)	Docket Nos. 52-040-COL and 52-041-COL ASLBP No. 10-903-02-COL-BD01 July 10, 2017

INITIAL DECISION

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I. INTRODUCTION

Florida Power & Light Company (FPL) seeks a combined license (COL) for each of two new nuclear power reactors, Turkey Point Units 6 and 7, to be constructed at FPL's facility near Homestead, Florida. This proceeding concerns a challenge (Contention 2.1) to FPL's COL application by Mark Oncavage, Dan Kipnis, Southern Alliance for Clean Energy, and National Parks Conservation Association (hereinafter referred to as Joint Intervenors). Contention 2.1 asserts:

> The Final Environmental Impact Statement (FEIS) is deficient in concluding that the environmental impacts from FPL's proposed deep injection wells will be "small." The chemical concentrations of ethylbenzene, heptachlor, tetrachloroethylene, and toluene in the wastewater injections, see FEIS Table 3-5, may adversely impact the groundwater should they migrate from the Boulder Zone to the Upper Floridan Aquifer.

Notice of Hearing, 82 Fed. Reg. 16,241, 16,242 (Apr. 3, 2017).

Having fully considered the record evidence, including the testimony presented at the evidentiary hearing on May 2–3, 2017, we conclude that the NRC Staff has demonstrated by a preponderance of the evidence that the environmental impacts from FPL's proposed deep injection wells will be "small" because (1) the wastewater is unlikely to migrate to the Upper Floridan Aquifer; and (2) even if it did, the concentration of each of the four contaminants would be below the applicable United States Environmental Protection Agency (EPA) primary drinking water standard and, accordingly, would pose no known health risk.

II. FACTUAL BACKGROUND

Joint Intervenors challenge the FEIS's analysis of the potential impacts of FPL's plan to inject wastewater from the mechanical draft cooling towers for proposed Units 6 and 7 into the Boulder Zone underlying the Turkey Point site. More specifically, they argue that four particular contaminants in the wastewater may harm the drinking water if they migrate from the Boulder Zone to the Upper Floridan Aquifer. To contextualize this challenge, we provide the following factual background concerning (1) the wastewater that FPL will use for the Turkey Point cooling towers, and the deep injection wells that FPL will use to dispose of that wastewater by injecting it into the Boulder Zone beneath the Turkey Point site; (2) the hydrogeology at the Turkey Point site; and (3) the four chemical contaminants in the wastewater at issue in this case, along with their corresponding drinking water standards.

A. The Proposed Cooling System at the Turkey Point Site and the Deep Injection Wells

The water FPL will use as makeup water in the cooling towers will be treated wastewater from the Miami-Dade Water and Sewer Department's South District Wastewater Treatment Plant (SDWTP), which is located about nine miles north of the Turkey Point site.[1] This wastewater receives three levels of treatment before arriving at the Turkey Point site. First, prior to its arrival at the SDWTP, it receives pretreatment from industrial users to remove contaminants from the waste streams.[2] Second, when the wastewater reaches the SDWTP, it is treated as required by Florida regulations to remove total suspended solids and treat soluble organic matter. See Ex. NRC-002-R2 at 30–31; see also Fla. Admin. Code Ann. r. 62-600. Third, the wastewater is also treated at the SDWTP with high-level disinfectant in a two-step process that filters and then disinfects the wastewater to further reduce fecal coliform values (hereinafter referred to as high-level treatment). See Ex. NRC-002-R2 at 31; Fla. Admin. Code Ann. r. 62-600.440(6).

The treated wastewater will then be transported through nine miles of new pipeline running from the SDWTP to the Turkey Point site, where it will receive additional treatment at

[1] See Ex. FPL-064, Joint List of Undisputed Facts at 4 (Mar. 1, 2017); Ex. FPL-001, Pre-filed Direct Testimony of Paul Jacobs at 3 (Mar. 1, 2017). FPL does not expect any significant disruption to the supply of treated wastewater it receives from the SDWTP; however, if the wastewater were insufficient for Turkey Point's cooling needs, it would be supplemented with saltwater supplied by radial collector wells installed below the Biscayne Bay. See Ex. FPL-001 at 3–4. Contention 2.1 does not challenge the environmental consequences of FPL's potential use of saltwater for cooling purposes and, accordingly, we need not consider it.

[2] See Ex. NRC-002-R2, NRC Staff Testimony of Ann L. Miracle, Daniel O. Barnhurst, Paul D. Thorne, and Alicia Williamson-Dickerson Concerning Contention 2.1 at 30 (Apr. 14, 2017).

FPL's Reclaimed Wastewater Treatment Facility (FPL's Treatment Facility) before it is used in the cooling towers.[3] FPL's Treatment Facility will use filters and clarifiers to reduce contaminants such as magnesium, iron, oil and grease, total suspended solids, nutrients, and silica. See Ex. NRC-008A at 3-9.

After the above treatment, the wastewater will be stored at the makeup water reservoir for Units 6 and 7 to be used as cooling tower makeup water. See Ex. FPL-001 at 6; Ex. FPL-064 at 4. The wastewater will be circulated a maximum of four times through the cooling towers, where it will reach temperatures in excess of 110° Fahrenheit. See Ex. NRC-002-R2 at 7–8, 34. Additional wastewater will be continually added to the cooling towers to replace water that leaves the system through evaporation and drift (i.e., water droplets that are blown out of the cooling towers). See Ex. FPL-001 at 6–7.

Wastewater that has completed cycling through the cooling towers will be designated as "blowdown" and stored in the blowdown sump. See Ex. FPL-064 at 4.[4] FPL will use deep injection wells to dispose of this wastewater, injecting it underground to a depth of about 3,000 feet into a region in the Lower Floridan Aquifer known as the Boulder Zone. See id.

FPL ultimately will construct thirteen deep injection wells at the Turkey Point site. See Ex. FPL-064 at 4; see also Tr. at 667.[5] The construction and operation of these wells will be subject to Florida's Underground Injection Control (UIC) program, which (1) requires permits for the construction and operation of Class I injection wells of the type FPL plans to construct at

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[3] See Ex. NRC-008A, Division of New Reactor Licensing, Office of New Reactors and U.S. Army Corps of Engineers, Regulatory Division, Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 & 7, NUREG-2176, Volume 1 at 3-9 (Oct. 2016).

[4] As the wastewater cycles through the cooling towers, concentrations of minerals build up, reducing the wastewater's heat-removal efficiency and necessitating its transfer to the blowdown sump. See Ex. FPL-001 at 7.

[5] Of the thirteen wells, only two will need to operate simultaneously for the disposal of wastewater from the SDWTP. See Tr. at 877–78.

Turkey Point; and (2) subjects permitted wells to detailed monitoring requirements. See Fla. Admin. Code Ann. r. 62-528.410 to 62-528.425.[6]

Before commencing construction of its Class I injection wells, FPL must obtain construction permits from the Florida Department of Environmental Protection (FDEP). The issuance of a construction permit is conditioned on an applicant's demonstration of reasonable assurance that the well, throughout its construction and operation, will comply with Florida's UIC permitting program. See Fla. Admin. Code Ann. r. 62-528.450(1)(b). As relevant to this proceeding, the UIC permitting program requires an applicant to demonstrate "that the hydrogeologic environment is suitable for waste injection . . . without modifying the ambient water quality of other aquifers overlying the injection zone." Id. r. 62-528.405(1)(a). An injection well applicant must therefore show that (1) there is at least one confining zone above the injection zone to prevent fluid migration into an underground source of drinking water (USDW);[7] and (2) the proposed injection zone is capable of adequately receiving the injected fluid.[8] See id. r. 62-428.405(2)–(3). In areas where there is limited understanding of the geologic confinement, or where existing information indicates that confinement may be poor or lacking, Florida's UIC permitting program requires the applicant to first construct an exploratory well. See id. r. 62-528.450(1)(b).

An operation permit must also be obtained from FDEP for a Class I injection well. See Fla. Admin. Code Ann. r. 62-528.450(3)(e)–(f). Information acquired from the well during the

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[6] Federal law delegates the enforcement and administration of UIC programs to the states. See Safe Drinking Water Act, 42 U.S.C. § 300h-1.

[7] Pursuant to EPA regulations, an aquifer qualifies as a USDW if the aquifer or a portion of the aquifer has total dissolved solids in the groundwater of less than 10,000 milligrams per liter (mg/L), and if it contains a sufficient quantity of groundwater to supply a public water system. See 40 C.F.R. § 144.3.

[8] Joint Intervenors do not challenge the capability of the Boulder Zone to receive wastewater at the Turkey Point site.

construction process and operational testing period informs FDEP's decision as to whether to issue the operation permit. See id. r. 62-528.430(1)–(2), 62-528.455(2).

A permitted Class I injection well must also adhere to comprehensive monitoring requirements to ensure that the USDW is protected. For example, permittees must address their plans to construct monitor wells capable of monitoring (1) "[t]he absence of fluid movement adjacent to the well bore," and (2) "[t]he long-term effectiveness of the confining zone." Fla. Admin. Code Ann. r. 62-528.425(1)(g)1. They must also install devices on the injection wells to monitor flow rate and injection pressure. See id. r. 62-528.425(1)(a)–(b).

B. The Hydrogeology at the Turkey Point Site

As stated above, Florida's UIC permitting program seeks to ensure the effectiveness of the hydrogeologic confining zone to prevent upward migration of the injected fluid into any USDW. See Fla. Admin. Code Ann. r. 62-528.425(1)(g). To that end, FPL constructed an exploratory well (EW-1) to obtain data to confirm the existence of a confining zone at the Turkey Point site. See Ex. NRC-008A at 3-13.[9]

[9] Pursuant to Florida regulations, FPL will be required to obtain similar data for each of the injections wells it plans to construct at the Turkey Point site. See Fla. Admin. Code Ann. r. 62-528.405(2); Tr. at 702–03.

The figure below shows the general hydrogeology of the Turkey Point site based, inter alia, on data obtained from EW-1:

HYDROGEOLOGIC UNIT		DEPTH AT TOP OF LAYER (feet)
Biscayne Aquifer		0-3
Intermediate Confining Unit		140
Upper Floridan Aquifer (USDW)		1,010
Middle Floridan Confining Unit		1,450
	Primary Confining Layer	1,930
Lower Floridan Aquifer		2,915
	Boulder Zone	3,030

See Ex. NRC-008A at 2-48, fig. 2-19. As shown in this figure, two major aquifer systems exist beneath the Turkey Point site: (1) the surficial aquifer system, known as the Biscayne Aquifer; and (2) the Floridan aquifer system, which lies at the base of the Intermediate Confining Unit that separates the two aquifer systems.[10]

[10] The Floridan aquifer system has an area of approximately 100,000 square miles underlying all of Florida and parts of Alabama, Georgia, and South Carolina. See Ex. NRC-002-R2 at 40.

The Floridan aquifer system is comprised of three major units that, from shallowest to deepest, are (1) the Upper Floridan Aquifer; (2) the Middle Floridan Confining Unit; and (3) the Lower Floridan Aquifer. See Ex. NRC-008A at 2-53. Within the Lower Floridan Aquifer is the Boulder Zone, which is the zone targeted for deep-well injection of the wastewater from proposed Units 6 and 7. See id. at 2-54.

The Upper Floridan Aquifer at the Turkey Point site extends from 1,010 to 1,450 feet below ground surface, and it is designated as a USDW. See Ex. NRC-008A at 2-48.[11] It consists primarily of permeable limestone, dolomitic limestone, and dolomite. See id. The groundwater in the Upper Floridan Aquifer naturally flows in a general eastward direction. See id. at 2-55.

The Middle Floridan Confining Unit, or Middle Confining Unit, extends from 1,450 to 2,915 feet below ground surface and consists primarily of fine-grained limestone, dolomitic limestone, and dolomite. See Ex. NRC-008A at 2-54 to 2-55; Ex. FPL-002, Pre-filed Direct Testimony of David McNabb at 9 (Feb. 27, 2017). The lower portion of the Middle Confining Unit, between 1,930 and 2,915 feet below ground surface, is considered the primary confining layer for the injected wastewater at the Turkey Point site. See Ex. NRC-008A at 2-54 to 2-55.

The Lower Floridan Aquifer at the Turkey Point site begins at the base of the Middle Confining Unit, or 2,915 feet below ground surface, and the Boulder Zone begins at 3,030 feet below ground surface. See Ex. NRC-008A at 2-48. The Boulder Zone is comprised primarily of fractured dolostone, and it is highly permeable, probably due to horizontal caverns at multiple elevations connected by large vertical tubes within the zone. See id. at 2-54. The water in the Boulder Zone is very saline (similar to seawater). See id. The natural groundwater flow within the Boulder Zone around the Turkey Point site area is generally in a westward direction, see id.,

[11] Although the Upper Floridan Aquifer at the Turkey Point site is designated as a USDW, the water is too saline to use as drinking water without treatment. See Ex. NRC-008A at 2-54.

moving slowly at a rate of less than 60 feet per year, or 1.1 miles per century. See Ex. FPL-003, Pre-filed Direct Testimony of Robert G. Maliva at 24 (Mar. 1, 2017).[12]

C. The Four Contaminants at Issue in the Wastewater

Contention 2.1 alleges that four contaminants in the injected wastewater—heptachlor, ethylbenzene, toluene, and tetrachloroethylene[13]—will adversely impact the USDW in the Upper Floridan Aquifer should they migrate there from the Boulder Zone.[14]

Heptachlor is a chlorinated insecticide typically used for fire ant control. See Ex. FPL-004, Pre-filed Direct Testimony of Christopher M. Teaf at 7 (Feb. 27, 2017). The sale, distribution, and use of heptachlor was prohibited by EPA in 1988, save for the specific application of fire ant control in underground power transformers. See id. In water, heptachlor binds readily with sediments. See Ex. NRC-002-R2 at 18. It degrades primarily through chemical hydrolysis (i.e., the breakdown of chemicals when exposed to water, see Tr. at 860) and secondarily, though at a significantly slower pace, through volatilization (i.e., a process by which chemicals in water are transferred from an aqueous state to a gaseous state, see Tr. at 858) and photo degradation (i.e., the breakdown of chemicals when exposed to sunlight, see Tr. at 860). See Ex. NRC-002-R2 at 34–35; Ex. NRC-033, EPA, Office of Water, National Primary

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[12] When wastewater is injected under high pressure into the Boulder Zone, it will be forced out in all directions. See Ex. NRC-008A at 5-22. Initially, the injected wastewater will be buoyant, because it will have a lower density and a higher temperature than the native water in the Boulder Zone. See id. As a result of its buoyancy, the flow of the wastewater may temporarily be influenced by the configuration of the confining layer above the Boulder Zone that dips to the southwest, resulting in a northeast flow. See id. at 5-28. But as "mixing, cooling and dilution occur," id., buoyancy of the wastewater will decrease, and it will be subjected to the slow westward movement of the native water in the Boulder Zone. See id.

[13] In the parties' exhibits, tetrachloroethylene is sometimes referred to as tetrachloroethene. See, e.g., Ex. NRC-038, EPA, Method 624: Purgeables at 2 (1984). We refer to it throughout this decision as tetrachloroethylene.

[14] These four contaminants are in the wastewater prior to its arrival at the Turkey Point site from the SDWTP. See Ex. NRC-008A at 3-37.

Drinking Water Regulations, Containment Specific Fact Sheets, Synthetic Organic Chemicals – Technical Version at 36–37 (Oct. 1995).

Toluene, ethylbenzene, and tetrachloroethylene are highly volatile chemicals often found in facilities such as refineries and dry cleaners. See Ex. NRC-002-R2 at 19–21; Tr. at 858. Toluene occurs naturally in crude oil and is often used as a solvent for paint products. See Ex. FPL-004 at 10. Ethylbenzene also naturally occurs in petroleum and is commonly used as a solvent for pesticides and paint products. See id. at 9. Tetrachloroethylene is used as a solvent for dry cleaning and textile processing, and is also used as a degreasing agent. See id. at 11.

Table 3-5 in the FEIS lists the expected concentrations of these four contaminants immediately prior to FPL's injection of its wastewater into the Boulder Zone as follows: (1) heptachlor—0.000023 mg/L; (2) ethylbenzene—below the method detection limit; (3) toluene—0.00174 mg/L; and (4) tetrachloroethylene—0.00359 mg/L. See Ex. NRC-008A at 3-39, tbl. 3-5. The parties have stipulated that these values are "conservative and reliable." Ex. FPL-064 at 5.

Pursuant to the Safe Drinking Water Act, 42 U.S.C. §§ 300f et seq., EPA has developed Maximum Contaminant Levels (MCLs) for drinking water, which represent chemical concentrations that EPA has determined will not be harmful to public health, even if injected directly into drinking water. See 40 C.F.R. § 141.2. The pre-injection concentration listed in FEIS Table 3-5 for each of the four contaminants at issue in this case is below its EPA MCL.[15]

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[15] The EPA MCLs for the four contaminants are (1) heptachlor—0.0004 mg/L; (2) ethylbenzene—0.7 mg/L; (3) toluene—1.0 mg/L; and (4) tetrachloroethylene—0.005 mg/L. See Ex. FPL-064 at 5.

Florida has established State MCLs for drinking water. The Florida MCLs for heptachlor, ethylbenzene, and toluene are the same as the EPA MCLs. See Fla. Admin Code Ann. r. 62-550.828, tbls. 4–5. Florida's MCL for tetrachloroethylene is 0.003 mg/L, see id. tbl. 4, which is lower than the EPA MCL of 0.005 mg/L, and is slightly lower than the concentration for tetrachloroethylene listed in FEIS Table 3-5 of 0.00359 mg/L. However, in considering the potential environmental impacts of contaminants from deep injection wells, Florida does not view its MCLs as inflexibly rigid standards. See Tr. at 819–20.

EPA also has promulgated aspirational goals for drinking water called Maximum Contaminant Level Goals (MCLGs), which are “the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety.” 40 C.F.R. § 141.2. The EPA MCLGs for ethylbenzene (0.7 mg/L) and toluene (1.0 mg/L) are the same as the EPA MCLs for those contaminants. See Tr. at 805–07. Hence, the pre-injection concentrations in the wastewater of ethylbenzene (below the method detection limit) and toluene (0.00174 mg/L) are well below EPA’s aspirational drinking water goals. See id.

For potential carcinogens, including heptachlor and tetrachloroethylene, EPA set the MCLGs at zero, recognizing that (1) the MCLG represents a non-enforceable public health goal; (2) it is not technically possible to detect whether a true zero concentration is attained; and (3) treatment systems may not be able to effectively remove chemicals in their entirety from public water supplies. See Ex. FPL-062, Pre-filed Rebuttal Testimony of Christopher M. Teaf at 4 (Mar. 23, 2017). Thus, although the pre-injection concentrations in the wastewater of heptachlor (0.000023 mg/L) and tetrachloroethylene (0.00359 mg/L) are below EPA’s primary drinking water standards, they exceed EPA’s aspirational drinking water goal of zero.

III. PROCEDURAL HISTORY

In June 2009, FPL submitted its COL application for Turkey Point Units 6 and 7 to the NRC Staff. The application included an Environmental Report (ER), which is FPL’s assessment of the environmental impacts of the construction and operation of the proposed units. The ER concluded that the environmental impacts from FPL’s proposed groundwater injections will be “small.” See Ex. NRC-030, Turkey Point Units 6 & 7, COL Application, Part 3 – Environmental Report, Ch. 5 at 5.2-10 to 5.2-13, 5.2-25 (June 2009).

In June 2010, the NRC Staff published a notice of hearing and opportunity to petition to intervene.[16] The notice of hearing prompted the filing of several hearing requests and, as relevant here, this Board (1) granted Joint Intervenors' hearing request and admitted Contention 2.1;[17] and (2) granted the Village of Pinecrest's request to participate as an interested local governmental body.[18] See LBP-11-06, 73 NRC 149, 165, 251–52 (2011).

In February 2015, the NRC Staff issued its draft environmental impact statement (DEIS) that, like the ER, concluded that the environmental impacts from FPL's proposed groundwater injections will be "small."[19] Thereafter, this Board (1) granted the City of Miami's request to participate as an interested local governmental body, see LBP-15-19, 81 NRC 815, 828 (2015); and (2) granted in part FPL's motion for summary disposition of Contention 2.1. See LBP-16-03, 83 NRC at 185–86.

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[16] See [FPL COL] Application for the Turkey Point Units 6 & 7, Notice of Hearing, Opportunity to Petition for Leave to Intervene and Associated Order Imposing Procedures for Access to Sensitive Unclassified Non-Safeguards Information and Safeguards Information for Contention Preparation, 75 Fed. Reg. 34,777 (June 18, 2010).

[17] Contention 2.1 has been amended and reformulated since its initial admission. See, e.g., LBP-16-03, 83 NRC 169, 186 (2016); Licensing Board Memorandum and Order (Granting in Part and Denying in Part Motion for Summary Disposition of Amended Contention 2.1) at 10 (Aug. 30, 2012) (unpublished); LBP-12-09, 75 NRC 615, 629 (2012).

[18] Pursuant to NRC regulations, an entity that is admitted to a proceeding as an interested local governmental body shall be given the opportunity to "introduce evidence, interrogate witnesses where cross examination by the parties is permitted, advise the Commission without requiring the representative to take a position with respect to the issue, file proposed findings in those proceedings where findings are permitted, and petition for review by the Commission." 10 C.F.R. § 2.315(c).

[19] See Ex. NRC-007A, NUREG-2176, Vol. 1, Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7 (Draft Report for Comment) at 5-29 to 5-30 (Feb. 2015).

In October 2016, the NRC Staff issued its FEIS for Turkey Point Units 6 and 7.[20] Expanding upon the analysis in the DEIS,[21] the FEIS concludes that the environmental impacts from FPL's proposed groundwater injections will be "small" because (1) the upward migration of wastewater into the USDW is unlikely, see Ex. NRC-008A at 2-56 to 2-57, 5-21 to 5-29, 5-39 to 5-42, App. G at G-48 to G-52; and (2) even if the injected wastewater reaches the USDW in the Upper Floridan Aquifer, the impact on the groundwater will be small because the concentrations of the challenged contaminants are below their respective EPA MCLs. See id. at 3-37 to 3-39, 5-20 to 5-21.

On May 2–3, 2017, this Board held an evidentiary hearing in Homestead, Florida. At the outset of the hearing, we admitted the parties' prefiled exhibits into evidence, including the prefiled written direct and rebuttal testimony from their witnesses. See Tr. at 602–05.

At the hearing, Joint Intervenors presented oral testimony from a single witness, Mark A. Quarles, who has a B.S. in Environmental Engineering Technology and an M.B.A., is the Principal/Owner of Global Environmental, L.L.C., is licensed in Tennessee as a Professional Geologist, and has experience in the field of investigating accidental releases of environmental pollutants and evaluating the risks associated with such releases. See Ex. INT-001, Curriculum Vitae of Mark A. Quarles at 1 (undated); Ex. INT-002-R, Affidavit of Mark A. Quarles at 1 (Jan. 23, 2012).

FPL presented oral testimony from the following four witnesses: (1) Paul Jacobs, who has a B.S. in Nuclear Engineering, is the Supervising Engineer for the Turkey Point Units 6 and

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[20] The NRC Staff issued a supplement to the FEIS in December 2016. See Combined License Application for Turkey Point Nuclear Plant, Units 6 and 7, 81 Fed. Reg. 90,875 (Dec. 15, 2016).

[21] The NRC Staff added a review of studies analyzing past instances of upwelling at the SDWTP, see, e.g., Ex. NRC-008A at 5-23 to 5-26, and assessed FPL's modeling of projected horizontal and vertical migration of the injected wastewater. See id. at 5-26 to 5-29, App. G at G-48 to G-52. The NRC Staff also amended Table 3-5 in the FEIS to include updated sampling data taken from the SDWTP in 2013 and 2014 after the plant implemented its high-level disinfection system, which shows that the four relevant contaminants are below method detection limits. See id. at 3-39 tbl. 3-5 nn.(a)–(b).

7 project, and is licensed in California as a Professional Engineer, see Ex. FPL-001 at 1–2; (2) David McNabb, who has an M.S. in Geology, is the President of McNabb Hydrogeologic Consulting, Inc., is licensed in Florida as a Professional Geologist, and who provided design, permitting, and construction oversight services for EW-1 at Turkey Point, see Ex. FPL-002 at 1–2, 28; (3) Dr. Robert Maliva, who has a Ph.D. in Geology, is a Principal Hydrogeologist at WSP | Parsons Brinkerhoff, and is licensed in Florida and Texas as a Professional Geologist, see Ex. FPL-003 at 38; and (4) Dr. Christopher Teaf, who has a Ph.D. in Toxicology, is Director of Toxicology for Hazardous Substance & Waste Management Research, Inc., and has served as Director of the Center for Biomedical & Toxicological Research at Florida State University. See Ex. FPL-004 at 1.

The NRC Staff presented oral testimony from the following three witnesses: (1) Dr. Ann Miracle, who has a Ph.D. in Molecular Immunology, and is a Senior Scientist in the Earth Systems Science Division at the Pacific Northwest National Laboratory, see Ex. NRC-003, Curriculum Vitae of Ann L. Miracle at 1 (undated); (2) Daniel Barnhurst, who has an M.S. in Geology, is a Hydrogeologist in the Office of New Reactors at the NRC, and is licensed in Tennessee as a Professional Geologist, see Ex. NRC-004, Curriculum Vitae of Daniel O. Barnhurst at 1 (undated); and (3) Paul Thorne, who has an M.S. in Hydrology/Hydrogeology, is a Senior Research Scientist in the Earth Systems Science Division at the Pacific Northwest National Laboratory, and whose technical specialties include testing and analysis of fluid flow in geologic formations, and modeling of aquifers and subsurface flow. See Ex. NRC-005, Curriculum Vitae of Paul D. Thorne at 1–2 (undated).

Consistent with NRC regulations governing Subpart L hearings, see 10 C.F.R. § 2.1207(b)(6), Board members asked the witnesses questions in those areas that, in the Board's judgment, required additional clarification. The Board was assisted in this endeavor by proposed written questions that the parties provided prior to, and during the course of, the hearing. See Tr. at 597–98, 879, 881.[22]

On May 17, 2017, the parties submitted a joint motion for transcript corrections, and on May 31, 2017, this Board granted the motion and closed the record on Contention 2.1. See Licensing Board Order (Adopting Transcript Corrections) (May 31, 2017) (unpublished).[23]

IV. LEGAL STANDARDS

A. National Environmental Policy Act Standards

The National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321–4370f, has two principal objectives. First, it ensures that an agency considers every significant aspect of the environmental impact of a proposed action. See Balt. Gas & Elec. Co. v. Nat. Res. Def. Council, 462 U.S. 87, 97 (1983). Second, it ensures that the agency informs the public that it has, in fact, considered environmental concerns in its decision-making process. See id. To effect these cardinal goals, NEPA "directs that, to the fullest extent possible . . . all agencies of the Federal Government shall . . . include in every . . . major Federal action significantly affecting the quality of the human environment, a detailed statement by the responsible official on . . . the environmental impact of the proposed action." 42 U.S.C. § 4332(C)(i). The issuance of a COL is a "major federal action." See Blue Ridge Envtl. Def. League v. NRC, 716 F.3d 183, 188 (D.C. Cir. 2013). The requirement to prepare an environmental impact statement "ensures

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[22] Pursuant to NRC regulations, the parties' proposed questions "must be kept by the [Board] in confidence until they are either propounded by the [Board], or until issuance of the initial decision on the issue being litigated. The [Board] shall then provide all proposed questions to the Commission's Secretary for inclusion in the official record of the proceeding." 10 C.F.R. § 2.1207(a)(3)(iii). In accordance with this regulation, this Board will provide all proposed questions to the Commission's Secretary for inclusion in the record following issuance of this decision.

[23] Although the record on Contention 2.1 is closed, the record for this proceeding remains open pending the resolution of an April 18, 2017 petition to intervene and proffer a new contention submitted by the City of Miami, the City of South Miami, and the Village of Pinecrest. See Petition for Leave to Intervene in a Hearing on [FPL's] [COL] for Turkey Point Unit 6 & 7 and File a New Contention (Apr. 18, 2017).

that the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts." Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 349 (1989). In short, NEPA requires that an agency take a "hard look" at the environmental consequences of each planned action. See Marsh v. Oregon Nat. Res. Council, 490 U.S. 360, 374 (1989).

NEPA does not, however, require the NRC Staff to analyze every conceivable aspect of a proposed project. See Private Fuel Storage, LLC (Indep. Spent Fuel Storage Installation), CLI-02-25, 56 NRC 340, 349 (2002). Rather, NEPA's requisite "hard look" is subject to a "rule of reason." See, e.g., Nat. Res. Def. Council v. Morton, 458 F.2d 827, 834 (D.C. Cir. 1972). This means that agencies need not consider risks that are "remote and speculative" or events that have a very low probability of occurring. Limerick Ecology Action, Inc. v. NRC, 869 F.2d 719, 754–55 (3rd Cir. 1989). Additionally, NEPA "does not call for certainty or precision, but an estimate of anticipated (not unduly speculative) impacts." La. Energy Servs. (Nat'l Enrichment Facility), CLI-05-20, 62 NRC 523, 536 (2005) (emphasis in original).

Moreover, "NEPA itself does not mandate particular results, but simply prescribes the necessary process." Robertson, 490 U.S. at 350. Although NEPA establishes a national policy in favor of protecting the environment, it does not require the agency to select the most environmentally benign alternative. "NEPA merely prohibits uninformed—rather than unwise—agency action." Id. at 351. "If the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh the environmental costs." Id. at 350.

As part of its NEPA analysis, and consistent with the approach outlined in the Council for Environmental Quality's regulations, see 40 C.F.R. § 1508.27; 10 C.F.R. § 51.14, the NRC Staff categorizes the potential environmental impacts on a scale from small to large:

> SMALL—environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

> MODERATE—environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE—environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Ex. NRC-008A at 1-4 to 1-5.

B. Burden and Standard of Proof

In NRC licensing proceedings involving safety-related contentions, the license applicant bears the burden of proof. See 10 C.F.R. § 2.325; Consumers Power Co. (Midland Plant, Units 1 & 2), ALAB-283, 2 NRC 11, 17 (1975). In proceedings (like this one) that involve NEPA contentions, however, the NRC Staff bears that burden because it has the statutory obligation of complying with NEPA. See, e.g., Duke Power Co. (Catawba Nuclear Station, Units 1 & 2), CLI-83-19, 17 NRC 1041, 1049 (1983). To carry that burden, the NRC Staff must establish that its position is supported by a preponderance of the evidence. See Advanced Med. Sys., Inc. (One Factory Row, Geneva, Ohio 44041), CLI-94-06, 39 NRC 285, 302 n.22 (1994). A preponderance of the evidence "requires the trier of fact to believe that the existence of a fact is more probable than its nonexistence." Concrete Pipe & Prods. of Cal., Inc. v. Constr. Laborers Pension Tr. for S. Cal., 508 U.S. 602, 622 (1993).

V. FINDINGS OF FACT

Joint Intervenors contend that the FEIS errs in concluding that the environmental impacts from FPL's deep injection wells will be "small." They argue that the wastewater from the Turkey Point facility that will be injected into the Boulder Zone is likely to migrate to the Upper Floridan Aquifer and adversely impact the USDW. We find that the NRC Staff has shown by a preponderance of the evidence that the FEIS is correct in concluding that the environmental impacts from the deep injection wells will be "small" because (1) the wastewater is unlikely to migrate to the Upper Floridan Aquifer, see infra Part V.A; and (2) even if the wastewater were to migrate to the Upper Floridan Aquifer, the four contaminants at issue in this case will not adversely impact the USDW, because the pre-injection concentration of each contaminant is below its EPA MCL, or primary drinking water standard. See infra Part V.B.

A. The FEIS Correctly Concludes that the Wastewater FPL Injects into the Boulder Zone is Unlikely to Migrate to the Upper Floridan Aquifer

1. Data From the EW-1 Tests, Coupled with the Groundwater Modeling Performed by FPL and the NRC Staff, Support the FEIS's Conclusion that the Middle Confining Unit Will Prevent Wastewater From Migrating to the Upper Floridan Aquifer

Joint Intervenors challenge the FEIS's reliance on the EW-1 tests to support its conclusion that the Middle Confining Unit will prevent the migration of wastewater into the Upper Floridan Aquifer. First, Joint Intervenors argue that a proper interpretation of the EW-1 tests reveals that the Middle Confining Unit is not an effective confining layer. Second, they argue that, even assuming the FEIS properly interprets the EW-1 tests, a single exploratory well does not provide adequate information to reliably conclude that the Middle Confining Unit is an effective confining layer. We disagree with Joint Intervenors on both points.

a. FPL drilled a 3,232 foot deep exploratory well—EW-1—to satisfy FDEP permitting requirements for a Class I injection well. See Ex. NRC-008A at 2-57. As discussed supra Part II.A, FDEP regulations governing Class I injection wells require an applicant to demonstrate the existence of a confining zone that will prevent fluid migration into the USDW. See Fla. Admin. Code Ann. r. 62-528.405(2)(a). To that end, FPL used test results from EW-1 to "provide sufficient data, such as geophysical logs, lithologic cores, physical core analysis, borehole video television surveys, water samples, and drill stem tests (also known as packer tests) to adequately demonstrate the confining characteristics of the [Middle Confining Unit]." Ex. FPL-002 at 4; see also Fla. Admin. Code Ann. r. 62-528.405(2)(c).

In order to gather sufficient data to demonstrate adequate confinement, FPL took drill cutting samples every ten feet or less at EW-1, as well as water samples at 90-foot intervals. See Ex. NRC-056, Report on the Construction and Testing of Class V Exploratory Well EW-1 at the [FPL] Turkey Point Units 6 & 7, vol. 1 at 5–6 (Sept. 2012); Ex. FPL-002 at 5–6. FPL also collected ten 4-inch diameter rock cores between the depths of 1,721.5 and 2,679 feet within the Middle Confining Unit. See Ex. NRC-056 at 12; Ex. FPL-002 at 6. FPL then used these samples to perform laboratory analyses, geophysical logging,[24] and packer testing to determine the hydraulic parameters of the rock layers. See Ex. NRC-008A at 2-57.

In July 2013, FDEP concluded that the data from the EW-1 tests demonstrated that the Middle Confining Unit is an effective barrier that will prevent injected wastewater from migrating to the Upper Floridan Aquifer, and so it issued a permit to FPL enabling it to convert EW-1 into an injection well. See Ex. FPL-002 at 4.

In the FEIS, the NRC Staff cites data from the EW-1 tests to show that (1) the primary confinement for the injected wastewater is the lower part of the Middle Confining Unit between 1,930 and 2,915 feet below ground surface and is composed of limestone, dolomitic limestone, and dolomite; and (2) this 985-foot-thick strata "likely provides a barrier to vertical groundwater flow." See Ex. NRC-008A at 2-57 to 2-58.[25]

Joint Intervenors' witness, Mr. Quarles, argued that—contrary to the conclusions of the FEIS—the following test results from EW-1 indicate that the Middle Confining Unit will not provide an effective barrier to vertical groundwater flow: (1) low percent bedrock recoveries; (2) high percent porosity of bedrock; and (3) inconclusive packer testing of bedrock intervals. See Ex. INT-022, Pre-filed Initial Testimony of Mark A. Quarles Regarding Joint Intervenors' Contention 2.1 at 6–7 (undated). We disagree.[26]

[24] NRC Staff witnesses, Mr. Barnhurst and Mr. Thorne, explained that "[b]orehole geophysical logging uses a sensor traveling through a borehole to measure the physical subsurface properties of the surrounding rock." Ex. NRC-002-R2 at 67.

[25] As discussed supra Part II.B, the Middle Confining Unit begins at 1,450 feet below ground surface and extends to 2,915 feet below ground surface. See Ex. NRC-008A at 2-48.

[26] Mr. Quarles raised two additional arguments regarding test results from EW-1. Neither argument is substantial. First, he asserted that FPL improperly relied on drill cuttings to determine "the presence of voids, fractures, faults, hydraulic capacity, or the confining nature of the bedrock," when such a determination based on drill cuttings "would be a qualitative, general evaluation" only. Ex. INT-022 at 10. However, as NRC Staff witnesses, Mr. Barnhurst and Mr.

First, contrary to Mr. Quarles' assertion, we find that low percent bedrock recoveries are not necessarily indicative of faults or voids in the bedrock. Bedrock recovery refers to the percentage of rock core actually recovered versus the total amount of the interval that underwent coring. See Ex. FPL-002 at 12–13. Thus, if a ten-foot interval underwent coring and only one foot of the rock core was recovered, the core recovery would be ten percent. See id. Within the primary confining layer of the Middle Confining Unit (between 1,930 and 2,915 feet below the ground surface), the percent bedrock recoveries from EW-1 ranged from 8 to 95.4 percent. See Ex. NRC-056 at 13, tbl. 3.

NRC Staff witnesses, Mr. Barnhurst and Mr. Thorne, and FPL witness, Mr. McNabb, testified that a variety of factors can negatively impact bedrock recovery percentages. See Ex. NRC-072 at 10; Ex. FPL-002 at 12–13. For example, a cored interval composed of soft rock—like the limestone and dolomite in the Middle Confining Unit, see Ex. NRC-008A at 2-58—can result in low percent core recovery because the rock can get washed away during the coring process or can fall out of the core barrel when the barrel is pulled to the surface. See Ex. FPL-002 at 12–13. Soft rock, however, is also indicative of the confining nature of the Middle Confining Unit, because such rock typically has low permeability. See id. at 13. Moreover, and significantly, FPL witness, Mr. McNabb, testified that no "bit drop" occurred during the coring process. Id. A "bit-drop" is "a term used when a void is encountered during drilling or coring that indicates the drill bit or the core barrel freely fell through a void or cavity." Id. The absence of any bit drop during the coring process of EW-1 is persuasive evidence of the absence of any such voids and is indicative of an adequate confining layer. See id.

Thorne, testified, the drill cuttings were in fact used only to make "a qualitative, general evaluation" of the bedrock. Ex. NRC-072, NRC Staff Rebuttal Testimony of Ann L. Miracle, Daniel O. Barnhurst, and Paul D. Thorne Concerning Contention 2.1 at 12 (Mar. 23, 2017) (quoting Ex. INT-022 at 10). Mr. Quarles also criticized the allegedly inadequate number of core samples taken from the bedrock. See Ex. INT-022 at 10. We find, however, that FPL purposefully—and quite reasonably—selected the number and location of the core samples to target the Middle Confining Unit and thereby evaluate its capacity for confinement. See Ex. NRC-072 at 13.

We also reject Mr. Quarles' assertion that the high percentage porosity of some core samples from the Middle Confining Unit indicates that the bedrock is permeable. As stated above, FPL collected ten core samples from EW-1 in the Middle Confining Unit between the depths of 1,721.5 and 2,679 feet below ground surface. See Ex. NRC-056 at 13, tbl. 3. From these ten cores, a total of sixteen samples underwent laboratory analysis for porosity, see id. at 18, and the porosity from those samples ranged from 27.4 to 43.4 percent. See id. at 19, tbl. 5. We credit the testimony of NRC witnesses, Mr. Barnhust and Mr. Thorne, and FPL witness, Mr. McNabb, who explained that this range of porosity data does not, in this case, indicate permeability. See Ex. NRC-072 at 10–11; Ex. FPL-002 at 12–13. Although an individual rock sample can contain many pores, it will have low permeability if the pores are not all interconnected. See Ex. FPL-002 at 12. As Mr. Barnhurst and Mr. Thorne testified, "[t]he ability of porous media to transmit water is indicated by hydraulic conductivity" rather than high percent porosity. Ex. NRC-072 at 10. FPL's laboratory testing of the sixteen core samples showed vertical hydraulic conductivity measurements ranging from a low of 1.1×10^{-6} centimeters per second (cm/second) to a high of 5.4×10^{-4} cm/second, thereby indicating that the cored intervals are confining in nature. See Ex. NRC-056 at 19, tbl. 5; Ex. FPL-002 at 13; Ex. NRC-072 at 11.

Finally, we reject Mr. Quarles' assertion that the failure of eight packer tests performed in the Middle Confining Unit indicate that the bedrock is permeable. See Ex. INT-022 at 8–9. A packer test measures permeability of the bedrock by "isolating a section of a borehole by placing a plug at each end of the interval to be tested, and then injecting or removing fluid from the isolated borehole section under controlled conditions and measuring both flow rates and pressure responses." Ex. NRC-002-R2 at 67. These plugs or "packers" are run into the well bore and then inflated to seal the tested interval. See Ex. FPL-002 at 7. Although eight of fourteen packer tests FPL performed in the Middle Confining Unit failed,[27] see Ex. NRC-056 at

[27] FPL performed a total of nineteen packer tests, fourteen of which were performed in the Middle Confining Unit. See Ex. NRC-056 at 21, tbl. 6.

21, tbl. 6, that is not a definitive indicator of permeable bedrock, because packer tests can fail for reasons independent of a geologic strata's permeability. For example, a packer test can fail because the inflatable packer fails to fully isolate the test interval thereby allowing water to flow through. See Ex. FPL-002 at 14. For EW-1, FPL witness, Mr. McNabb, explained that many of the failed packer tests in the Middle Confining Unit took place in a large diameter borehole, which required FPL to place sleeves on the packers to increase their diameter. See id. He testified that "these sleeves decreased the ability of the inflatable packers to conform to the configuration of the borehole, preventing isolation of the test interval." Id.

As further evidence that a failed packer test is not necessarily indicative of permeable bedrock, Mr. McNabb compared the results of packer tests #14 and #19—both of which were performed in the Middle Confining Unit. See Ex. FPL-002 at 14; see also Ex. NRC-056 at 21, tbl. 6. Packer test #14 failed after attempting to isolate the interval from 2,480 to 2,502 feet. See Ex. NRC-056 at 21, tbl. 6. By contrast, packer test #19 succeeded, and it was performed at an interval just two feet shallower than packer test #14 (2,478 to 2,500 feet). See id. Voids or fractures in the bedrock could not have caused the failure of test #14 because such geologic conditions would have also caused the failure of test #19. See Ex. FPL-002 at 14; see also Ex. NRC-056 at 21, tbl. 6. Moreover, in addition to packer test #19, five other packer tests in the Middle Confining Unit were successful and demonstrated low permeability. See Ex. NRC-056 at 21, tbl. 6.

Importantly, FPL also performed groundwater model simulations based on the hydrogeological data from EW-1 to confirm that migration from the Boulder Zone to the Upper Floridan Aquifer is highly unlikely. See Ex. FPL-003 at 18–22.[28] These simulations, created by

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[28] As explained by FPL witness, Dr. Maliva, the groundwater modeling used "a density-dependent, solute-transport code that was developed by the United States Geological Survey for the simulation of water flow and solute transport in aquifers with significant salinity (and thus density) differences . . . [and that] incorporates temperature effects on buoyancy." Ex. FPL-003 at 18.

FPL witness Dr. Maliva, used conservative assumptions "to provide reasonable assurance that the proposed injection well will not cause adverse impacts." Id. at 20. Dr. Maliva testified that "the results of all my simulations indicate that the top of the injected wastewater will be located at least over 1,000 feet below the base of the USDW at the Turkey Point site after a hundred years." Id. at 22.

The NRC Staff performed an independent modeling analysis to determine the maximum extent that wastewater might migrate upward, and it concluded that any upward migration would be even less than FPL's analysis indicated. See Ex. NRC-008A at 5-27. The NRC Staff's analysis indicated that "the injectate would move less than 300 [feet] upward into the [Middle Confining Unit] over a 100 [year] period."[29]

In sum, hydrogeological data from the EW-1 tests, as well as sophisticated groundwater modeling based on those tests, refute Joint Intervenors' assertion that significant upwelling of wastewater from the Boulder Zone is likely to occur at the Turkey Point site. We find that the NRC Staff demonstrated by a preponderance of the evidence that the EW-1 tests strongly support the FEIS's conclusion that wastewater injected into the Boulder Zone is unlikely to migrate to the Upper Floridan Aquifer.

b. In addition to challenging the NRC Staff's and FPL's analysis of data from the EW-1 tests, Joint Intervenors criticized the adequacy of that data, claiming that data from one exploratory well was insufficient to establish confinement for a deep injection well. See, e.g., Ex. INT-022 at 5–6. We disagree. Construction of more than one exploratory well is not required by FDEP regulations or by industry standards. See Ex. FPL-003 at 10; see also Ex. NRC-002-R2 at 43–44. Indeed, given the high cost of drilling such wells, and the fact that the

[29] Ex. NRC-008C, Division of New Reactor Licensing, Office of New Reactors and U.S. Army Corps of Engineers, Regulatory Division, Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 & 7, NUREG-2176, Volume 3, App. G at G-50 (Oct. 2016).

"hydrogeology of the Floridan Aquifer System does not vary significantly over short distances, i.e., within a few miles," Ex. FPL-060, Pre-filed Rebuttal Testimony of David McNabb at 3 (Mar. 23, 2017), no applicant for a Class I injection well permit in Florida has ever been required to drill more than one exploratory well for an injection well. See Ex. FPL-002 at 11–12; Ex. FPL-003 at 10. Nothing in this record persuades us that FPL should be the first injection well applicant to be required to drill more than one exploratory well, nor does NEPA's "rule of reason" impose such a requirement. See Entergy Nuclear Generation Co. (Pilgrim Nuclear Power Station), CLI-10-11, 71 NRC 287, 315 (2010) ("[W]hile there 'will always be more data that could be gathered,' agencies 'must have some discretion to draw the line and move forward with decisionmaking.'") (quoting Town of Winthrop v. FAA, 535 F.3d 1, 11 (1st Cir. 2008)).

Using a slightly different tack, Joint Intervenors argued that, in addition to obtaining data from an exploratory well, FPL should be required to obtain data using seismic-reflection surveys[30] to determine the potential for rapid vertical flow of wastewater through geologic faults and karst collapse structures at the Turkey Point site. See Ex. INT-022 at 6; Tr. at 691–94. Their witness, Mr. Quarles, cited several studies conducted by the United States Geological Survey (USGS)[31] that used seismic-reflection to assess subsurface geological systems in South

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[30] "Seismic-reflection surveys involve producing a shockwave at the surface and recording the return time and magnitude of reflected sound waves at an array of geophone receivers at other locations on the surface. These data are processed to remove extraneous noise and convert the time it takes for reflections to reach the geophones into depths of subsurface formations. The data are then interpreted to create a seismic-based visualization of the subsurface." Ex. NRC-072 at 13 (internal quotation marks omitted).

[31] These USGS studies are (1) Ex. NRC-050, Kevin J. Cunningham, et al., Near-Surface, Marine Seismic-Reflection Data Define Potential Hydrogeologic Confinement Bypass in the Carbonate Floridan Aquifer System, Southeastern Florida (2012); (2) Ex. NRC-051, Kevin J. Cunningham, Integrating Seismic-Reflection and Sequence-Stratigraphic Methods to Characterize the Hydrogeology of the Floridan Aquifer System in Southeast Florida (2013); (3) Ex. NRC-052, Kevin J. Cunningham, Integration of Seismic-Reflection and Well Data to Assess the Potential Impact of Stratigraphic and Structural Features on Sustainable Water Supply from the Floridan Aquifer System, Broward County, Florida (2014); and (4) Ex. NRC-053, Kevin J. Cunningham, Seismic-Sequence Stratigraphy and Geologic Structure of the Floridan Aquifer System Near "Boulder Zone" Deep Wells in Miami-Dade County, Florida (2015).

Florida. See Ex. INT-022 at 11–13. He stated that the most recent of these studies, conducted in 2015 (2015 USGS Study), "confirmed the presence of subsurface geologic faults and karst collapse structures [near the Turkey Point site at the Miami-Dade South District and North District Wastewater Treatment Plants] that can transmit injected wastewater upwards into the Upper Floridan aquifer." Id. at 11 (citing Ex. NRC-053). Joint Intervenors thus asserted that the NRC Staff did not comply with NEPA's "hard look" requirement because it failed to use site-specific seismic-reflection surveys. Tr. at 610, 691–94. We disagree.

At the outset, it is important to note that the FEIS actually examines the USGS studies cited by Mr. Quarles. See Ex. NRC-008A at 5-25. Acknowledging that no seismic-reflection survey was conducted at the Turkey Point site, the FEIS observes that the 2015 USGS Study suggests that evidence of karst collapse can be gathered through other methods, including borehole logs, which FPL performed at EW-1. See id. Additionally, the FEIS assesses the results of the USGS seismic-reflection surveys taken near the Turkey Point site, coupled with data collected from the EW-1 borehole logs, and concludes that the likelihood of vertical flow through faults in the Middle Confining Unit at the Turkey Point site is small. See id. Moreover, NRC Staff witnesses, Mr. Thorne and Mr. Barnhurst, testified that, to the extent the seismic-reflection surveys that were taken at the SDWTP near the Turkey Point site show faults, those features are either absent or confined to the Lower Floridan Aquifer in the areas closest to the Turkey Point site. See Ex. NRC-072 at 17.

Mr. Thorne and Mr. Barnhurst also cited instances where seismic-reflection surveys failed to "reveal the existence of a tectonic fault or karst collapse structure." Ex. NRC-072 at 18. Moreover, Mr. Thorne and Mr. Barnhust, along with FPL witness, Dr. Maliva, testified that although such a survey can identify a fault or karst collapse structure, it will not indicate whether such a feature is hydraulically conductive. See id.; see also Ex. FPL-003 at 34. Dr. Maliva testified that "[s]ome faults are actually impermeable and act to seal off aquifers and hydrocarbon reservoirs." Ex. FPL-061, Pre-filed Rebuttal Testimony of Robert G. Maliva at 8

(Mar. 23, 2017). Finally, such surveys have never been a permitting requirement for a Class I injection well. See id.

We find that FPL acted reasonably—and consistently with FDEP regulations and industry standards—in not conducting a seismic-reflection survey at Turkey Point. Such a survey is not required to satisfy NEPA, especially given that (1) it might fail to reveal a fault or fracture; and (2) its results provide no definitive information on the hydraulic conductivity of any identified fault or fracture. "NEPA 'should be construed in the light of reason if it is not to demand' virtually infinite study and resources." Pilgrim, CLI-10-11, 71 NRC at 315 (footnote omitted) (quoting Nat. Res. Def. Council v. Hodel, 865 F.2d 288, 294 (D.C. Cir. 1988)). "NEPA allows agencies 'to select their methodology as long as that methodology is reasonable.'" Id. at 316 (quoting Town of Winthrop, 535 F.3d at 13). In our judgment, the FEIS's conclusion that injected wastewater at the Turkey Point site is unlikely to migrate to the Upper Floridan Aquifer is based on reasonable analytic methodology and adequate evidence, and therefore satisfies NEPA.

2. The NRC Staff's Review of Regional Hydrogeological Studies Supports the FEIS's Conclusion that the Middle Confining Unit Is a Competent Confining Layer

In preparing the FEIS, the NRC Staff reviewed numerous regional studies that examined hydrogeological conditions of areas in the vicinity of the Turkey Point site. The NRC Staff determined these studies generally support the conclusions that (1) wastewater is not likely to migrate upward slowly through the unfractured matrix of the Middle Confining Unit; and (2) wastewater is not likely to migrate upward rapidly through a fault or fracture. In the NRC Staff's view, these studies also support a conclusion that past instances of rapid upward migration of wastewater at deep injection wells near the Turkey Point site were likely caused by improper well construction, not by faults or fractures in the Middle Confining Unit. Joint Intervenors challenge the above conclusions. We reject their challenges, concluding that the

FEIS adequately considers the studies and reasonably determines that upward migration of wastewater through the Middle Confining Unit is unlikely.

a. The NRC Staff reviewed regional hydrogeological studies to assess the likelihood of wastewater reaching the Upper Floridan Aquifer by migrating slowly across a broad area through the unfractured matrix of the Middle Confining Unit. See Ex. NRC-008A at 5-23. The NRC Staff determined these studies "generally conclude that the [Middle Confining Unit] matrix provides adequate confinement." Id.[32]

Joint Intervenors' witness, Mr. Quarles, contended that the NRC Staff's reliance on these studies was misplaced, arguing, for example, that the 2001 study by R.C. Starr, et al. (Starr Study) "contradicts" the FEIS's conclusion, Ex. INT-022 at 14, because it states that "the confining layer above the Boulder Zone may in fact be competent, [but] these data sets are not adequate to draw this conclusion." Ex. NRC-044 at 39.

Contrary to Mr. Quarles' assertion, the Starr Study's concession about the inadequacy of its data sets does not contradict the FEIS. Importantly, the FEIS actually discusses this aspect of the Starr Study, see Ex. NRC-008A at 5-24, and it ultimately determines that the study supports a conclusion that wastewater will not reach the Upper Floridan Aquifer by migrating slowly across a broad area of the Middle Confining Unit. The FEIS explains:

> Rather than indicating a lack of confinement by the [Middle Confining Unit], the [Starr Study] concludes that the Middle Confining Unit and/or upper portion of the Lower Floridan Aquifer is a better confining unit than indicated by the data that was provided for review. The [Starr Study] concluded that overall the spatial distribution of contaminants [from upwelling of wastewater

[32] The studies reviewed by the NRC Staff included (1) a 2001 study by R.C. Starr, et al. (Starr Study), see Ex. NRC-044, R.C. Starr et al., Evaluation of Confining Layer Integrity Beneath the South District Wastewater Treatment Plant, Miami-Dade Water and Sewer Department, Dade County, Florida (2001); (2) a 2007 study by Robert G. Maliva, et al. (Maliva Study), see Ex. INT-014, Robert G. Maliva, et al., Vertical Migration of Municipal Wastewater in Deep Injection Well Systems, South Florida, USA (2007); and (3) a 2002 study by Donald F. McNeill (2002 McNeill Study), see Ex. NRC-064, Donald F. McNeill, A Geological Review of the Confining Capability of a Regional Dolomite Unit: Application to the MDWAS South District WWTP (2002). See Ex. NRC-008A at 5-23 to 5-24.

> at the SDWTP] suggests that . . . contaminants are not migrating upward through the Middle Confining Unit across a broad area.

Id. (internal quotation marks omitted).

Regarding Mr. Quarles' other criticisms of the NRC Staff's review of the regional studies, see Ex. INT-022 at 14–15, we find his arguments to be in the nature of unproductive "flyspecking." Hydro Res., Inc. (P.O. Box 15910, Rio Rancho, NM 87174), CLI-01-04, 53 NRC 31, 71 (2001) ("One can always flyspeck an FEIS to come up with more specifics and more areas of discussion that conceivably could have been included."). The FEIS provides an extensive discussion of the relevant studies, including their limitations, before concluding that upward migration to the Upper Floridan Aquifer across a broad area of the Middle Confining Unit is unlikely. This discussion is sufficient under NEPA. See Myersville Citizens for a Rural Cmty., Inc. v. FERC, 783 F.3d 1301, 1324–25 (D.C. Cir. 2015) (Under NEPA's "hard look" standard, an agency's analysis is adequate if it "contains sufficient discussion of the relevant issues and opposing viewpoints,' and . . . the agency's decision is 'fully informed' and 'well-considered.'") (internal citations omitted).

b. In addition to reviewing regional studies to consider the potential for relatively slow migration of wastewater through the unfractured matrix of the Middle Confining Unit, the FEIS also considers the potential for rapid migration through faults or fractures.[33] In particular,

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[33] The studies the FEIS reviews regarding past instances of rapid upwelling in South Florida include (1) the 2002 McNeill Study, see Ex. NRC-064; (2) a 2010 study by Alyssa M. Dausman, et al. (2010 Dausman Study), see Ex. FPL-009, Alyssa M. Dausman, et al., Hypothesis Testing of Buoyant Plume Migration Using a Highly Parameterized Variable-Density Groundwater Model at a Site in Florida, USA (2010); and (3) a 2010 study by Virginia Walsh & René M. Price (2010 Walsh and Price Study), see Ex. FPL-028, Virginia Walsh & René M. Price, Determination of Vertical and Horizontal Pathways of Injected Fresh Wastewater Into a Deep Saline Aquifer (Florida, USA) Using Natural Chemical Tracers (2010). See Ex. NRC-008A at 5-24 to 5-25.

As discussed supra Part V.A.1, the FEIS also examines USGS reports from 2012–2015, which utilized seismic-reflection data, to evaluate the likelihood of rapid migration of the wastewater to the USDW at the Turkey Point site through fractures and faults. See Ex. NRC-008A at 5-25.

the FEIS focuses on the possible causes of prior instances of upwelling through the Middle Confining Unit that occurred in southeast Florida, including the SDWTP, which is about nine miles north of the Turkey Point facility. See Ex. NRC-008A at 5-23.[34] After reviewing these studies, the FEIS ultimately concludes that the past instances of vertical migration in South Florida were not caused by faults or fractures in the Middle Confining Unit, but were likely caused by well construction problems. See id. at 5-23 to 5-26.[35]

Joint Intervenors' witness, Mr. Quarles, opined that the FEIS errs in attributing past instances of vertical migration to well-related issues. According to Mr. Quarles, the studies cited by the FEIS indicate that faults and fractures in the Middle Confining Unit are the more likely cause of past upwelling and thus contradict the FEIS's conclusion that the upwelling was due to well construction problems. See Ex. INT-022 at 16–17. For example, Mr. Quarles relied on the 2015 USGS Study, which concluded, in relevant part, that:

> The strike-slip fault and karst collapse structures span confining units of the Floridan aquifer system and could provide high permeability passageways for groundwater movement. If present at or near wastewater injection utilities, these features represent a plausible physical system for the upward migration of effluent injected into the Boulder Zone to overlying [EPA] designated [USDWs] in the upper part of the Floridan aquifer system.

Id. (quoting Ex. NRC-053 at 24). Mr. Quarles asserted that the above passage contradicts the FEIS's conclusion that the upwelling at the SDWTP was likely caused by a well construction problem. See id. at 16.

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[34] Of the more than 180 Class I injection wells constructed in Florida, seventeen have experienced migration out of an injection zone, and three of these sites were in southeast Florida, including the SDWTP. See Ex. NRC-008A at 5-23; Ex. FPL-003 at 3.

[35] As discussed infra Part V.A.3, the FEIS concludes that (1) modern well construction techniques utilized by FPL will prevent well-related leaks at the Turkey Point site; and (2) even if a leak were to occur, the injection well monitoring program mandated by the FDEP UIC program will detect and resolve a well-related leak before any significant release reaches the Upper Floridan Aquifer.

Mr. Quarles is incorrect. The above passage simply states that faults and karst collapse structures in the Floridan Aquifer System "could" provide passageways for upward migration of wastewater "if" they exist "at or near" a deep injection well. See Ex. NRC-053 at 24. This statement does not contradict the FEIS; rather, it is a truism that the FEIS repeatedly acknowledges. See, e.g., Ex. NRC-008A at 5-22, 5-24, 5-25. But based on an in-depth review of the EW-1 tests, sophisticated groundwater modeling, and regional studies, including the 2015 USGS study that Mr. Quarles cites, the FEIS concludes that (1) significant vertical migration of wastewater out of the Boulder Zone due to fractures or faults in the Middle Confining Unit is not expected at the Turkey Point site; and (2) past instances of rapid vertical migration that occurred near the Turkey Point site were likely due to well-related issues. See Ex. NRC-008A at 5-21 to 5-26; see also Ex. NRC-002-R2 at 56–57. Mr. Quarles' mere disagreement with the FEIS does not render it deficient. NEPA's "hard look" standard requires an agency to discuss the relevant issues and opposing viewpoints to ensure that "the agency's decision is 'fully informed' and 'well-considered.'" Myersville Citizens for a Rural Cmty., 783 F.3d at 1325. We find that the NRC Staff's analysis satisfied NEPA, and that its conclusions were reasonable and supported by the record.

3. The FEIS Reasonably Concludes that Well-Related Problems Are Not Likely to Cause Upward Migration of Wastewater, and that a Well-Related Leak Would Likely Be Detected and Resolved Prior to any Significant Release to the Upper Floridan Aquifer

In light of the NRC Staff's conclusion that well-related problems were the likely cause of past instances of rapid vertical migration of wastewater at some Class I injection wells, the NRC Staff considered whether such problems were likely to occur at the Turkey Point site. As part of its analysis, the NRC Staff considered the testing and monitoring requirements of the FDEP UIC program, which regulates the type of deep injection wells proposed for the Turkey Point site. See Ex. NRC-008A at 5-21. This analysis led the NRC Staff to conclude that (1) well problems that may have caused upward migration of wastewater at other injection well sites are not expected to occur at the Turkey Point site, see id. at 2-56, 5-40; and (2) if an injection well leak were to occur at the Turkey Point site, it would likely be detected and resolved before any significant release reached the Upper Floridan Aquifer. See id. at 5-40; see also Ex. NRC-008B, Division of New Reactor Licensing, Office of New Reactors and U.S. Army Corps of Engineers, Regulatory Division, Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 & 7, NUREG-2176, Volume 2 at 7-17 (Oct. 2016). We find that both conclusions are supported by adequate evidence.

a. First, the FEIS concludes that well construction problems that may have been responsible for past upwellings at other injection well sites are not expected to occur at the Turkey Point site. See Ex. NRC-008A at 2-56, 5-40. FPL witness, Mr. McNabb, explained that injection wells built over 25 years ago used the construction technique of drilling a pilot hole, performing testing on the pilot hole, and then reaming the pilot hole to a larger diameter for installing the injection well's steel casing. See Ex. FPL-002 at 15. This process could create a double borehole if, while reaming the pilot hole, the reaming drill did not directly follow the pilot hole for the injection well. This, in turn, would result in "a large diameter borehole that the casing was installed into and an open pilot hole through the confinement that can act as a direct conduit for injected fluid to move upward." Id. at 15–16; see also Ex. NRC-008A at 2-56. The modern approach that has been used for about the past 25 years—and the approach to be taken at the Turkey Point site—is to backplug the pilot hole with cement after pilot testing and before the drilling of the injection well, thereby preventing the possibility of a double borehole that can result in rapid vertical migration. See Ex. NRC-008A at 2-56. Mr. McNabb testified that injection well sites where vertical migration has occurred in the past were built "at least 25 years ago, when construction techniques were different." Ex. FPL-002 at 15. "[S]ince we've changed our construction techniques [to include backplugging of the pilot hole],” declared Mr. McNabb, “we’re just not seeing the problems that we were having.” Tr. at 750.[36]

Additionally, the integrity of FPL’s deep injection wells will be verified by the rigorous construction and well-testing requirements of FDEP’s UIC permitting process that, in turn, will minimize the possibility of leakage. See Ex. NRC-008A at 5-21, 5-26; Tr. at 734–43, 755–57, 759–66. As discussed in the FEIS, FPL’s injection wells will be constructed of multiple concentric steel casings, each with a wall thickness of 3/8 or 1/2 inch, and cemented into place. See Ex. NRC-008A at 3-10, 3-13. A fiberglass reinforced plastic injection liner, selected for its corrosion resistance, will be inside the smallest (24 inch) casing. The annular space between the smallest casing and the injection liner will be sealed at the base of the tubing and at the surface and filled with a corrosion inhibiter, protecting the inside of the casing from corrosion. Cement will be poured around the perimeter of the casings for the entire length of the well, creating a seal between the casings and the surrounding bedrock to (1) prevent the movement of fluids into the USDW; (2) maintain the quality of groundwater in aquifers above the injection zone; and (3) protect the outside of the casings from corrosion. See Ex. FPL-002 at 14–15; Tr. at 735–39, 753–54, 765–66. Moreover, and as will be discussed in greater detail infra Part V.A.3.b, in compliance with FDEP UIC requirements, the continuing integrity of each well will be confirmed by (1) groundwater monitoring; (2) continuous pressure monitoring; and (3) periodic mechanical integrity tests. See Ex. FPL-002 at 19.

Notably, when Joint Intervenors’ witness, Mr. Quarles, was asked whether he considered any FDEP requirement regarding the construction and testing of deep injection wells to be inadequate, he responded in the negative. See Tr. at 758. He nevertheless opined that well leakage might occur because sometimes “mistakes do happen.” Id. But Mr. Quarles’ highly speculative concern that some indeterminate construction-related mistake might impair

[36] Joint Intervenors’ witness, Mr. Quarles, agreed that “backplugging [of the pilot hole] is a great idea that should be done.” Tr. at 730.

the integrity of an injection well does not impugn the adequacy of the NRC Staff's NEPA review regarding the effectiveness of the FDEP UIC permitting program. Moreover, in examining the FDEP requirements, it was reasonable for the NRC Staff to expect that the state regulatory authority charged with permitting the injection wells will adequately enforce its own regulations. The "well-recognized presumption of administrative regularity" that applies to the NRC Staff in the execution of its official duties, Ark. Power & Light Co. (Ark. Nuclear One Unit 2), ALAB-94, 6 AEC 25, 28 (1973), likewise applies to State regulatory officials. See S. Cal. Edison Co. (San Onofre Nuclear Generating Station, Units 2 & 3), ALAB–308, 3 NRC 20, 30 (1976) (rejecting intervenors' argument that an applicant's proposal did not conform to the terms of a state permit and stating that "[i]t is for the [state agency] to . . . enforce the terms of its own permit"). In sum, we find that the NRC Staff independently, and adequately, considered the FDEP UIC permitting requirements among other factors to reach its conclusion that significant upwelling of injected wastewater due to well leakage is not likely at the Turkey Point site. See Ex. NRC-008A at 5-26.

b. The FEIS concludes that even if a leak were to occur in an injection well, it would likely be detected and resolved pursuant to the monitoring requirements of the FDEP UIC program before any significant release reached the Upper Floridan Aquifer. See Ex. NRC-008A at 5-26, 5-40; see also Ex. NRC-008B at 7-17. As the FEIS explains, FPL ultimately will install six additional dual-zone monitor wells along with the additional twelve injection wells. See Ex. NRC-008A at 3-10, 3-25. Each dual-zone monitor well will be located 75 feet from an injection well, and each monitor well will sample groundwater at two different depths: (1) below the Upper Floridan Aquifer (in the Middle Confining Unit); and (2) above the base of the Upper Floridan Aquifer (in the Upper Floridan Aquifer). See id. at 3-25; Ex. NRC-002-R2 at 44. FPL witness, Mr. McNabb, testified that the placement of the monitor wells proximate to the injection wells, coupled with the fact that they monitor groundwater in two different zones or depths, will allow FPL to “detect upward fluid movement or leaks, before any drinking water is impacted.” Ex. FPL-002 at 17.[37]

Joint Intervenors’ witness, Mr. Quarles, argued that the above groundwater monitoring system is inadequate because the wastewater may migrate horizontally beyond the detection capacity of the dual-zone monitors before it migrates upwards. See Ex. INT-022 at 23. FPL’s witness, Mr. McNabb, conceded that the scenario posited by Mr. Quarles was conceivable, but he declared that it was “highly unlikely” for two reasons. Tr. at 795. First, as discussed supra Parts V.A.1 and V.A.2, the FEIS correctly concludes that extensive horizontal migration coupled with vertical migration into the Upper Floridan Aquifer is unlikely. See Ex. NRC-008A at 5-26 to 5-28; see also Ex. FPL-003 at 24. Second, FDEP regulations mandate that dual-zone monitor wells be located near the injection wells, because the greatest potential for upward fluid migration occurs near the injection wells where (1) the greatest injection pressure occurs; and (2) the wastewater has its greatest buoyancy. See Tr. at 792–93; Ex. FPL-002 at 20. As Mr. McNabb testified, if the wastewater were to migrate horizontally for a mile and beyond the detection capacity of a monitor well, the wastewater “would be very dilute by then . . . . [And] we’d have very, very little buoyant force” for vertical migration. Tr. at 795.[38] We credit Mr. McNabb’s testimony, finding that Mr. Quarles’ criticism of the location of the dual-zone monitor wells does not undermine the FEIS’s conclusion that leakage from an injection well would likely be detected and resolved pursuant to the monitoring requirements of the FDEP UIC program before any significant release reached the Upper Floridan Aquifer.

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[37] Pursuant to FDEP regulations, water samples from the dual-zone monitor wells will be collected on a weekly basis during the first six months to two years of operation, and monthly thereafter. See Ex. FPL-002 at 17.

[38] The natural groundwater flow within the Boulder Zone at the Turkey Point site is exceedingly slow, moving at a rate of less than 60 feet per year. See Ex. FPL-003 at 24. Accordingly, if any leakage occurred in or near the Boulder Zone, it would take nearly 100 years for the wastewater to migrate horizontally for a distance of one mile, see id., at which point it would have “very little buoyan[cy]” as a result of dilution. Tr. at 795.

Our conclusion is buttressed by the fact that the monitoring program employed by FPL will not rely solely on dual-zone monitors to identify a leak in an injection well. Rather, in accordance with FDEP requirements, FPL will also continuously monitor the pressure of the sealed annular space between the final casing and the injection tubing. See Ex. FPL-002 at 18. This pressure monitoring system will immediately identify any leak in the well. See id. at 19. If FPL discovered that a well was leaking, it would report the event to FDEP and work with FDEP to resolve the problem.[39]

FDEP regulations also require that each injection well undergo mechanical integrity testing at least every five years. See Ex. FPL-002 at 18. As its name suggests, mechanical integrity testing serves to confirm that the injection well does not leak and that it otherwise continues to comply with FDEP UIC requirements. The testing includes (1) a video survey of the injection tubing and injection zone; (2) a pressure test where the annular space between the final casing and the fiberglass reinforced plastic injection tubing is pressurized; and (3) performance of a high-resolution temperature log and radioactive tracer survey on the well. See id.; see also Tr. at 759–66.

In sum, we find that, contrary to Joint Intervenors' argument, the FEIS reasonably concludes that even if a leak were to occur in an injection well, it would likely be detected and resolved pursuant to the monitoring requirements of the FDEP UIC program before any significant release reached the Upper Floridan Aquifer. See Ex. NRC-008A at 5-26, 5-40; see also NRC-008B at 7-17. That conclusion was based on a "hard look" at the relevant factors, and it is supported by ample evidence.

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[39] Potential remedies for a leaking well include (1) removing the well from service until the leak is repaired; and (2) ordering a well to be plugged or abandoned. See Ex. FPL-002 at 20.

B. The FEIS Correctly Concludes that Even if Wastewater Migrated to the Upper Floridan Aquifer, Its Environmental Impact Would be "Small" Due to the Low Concentrations of the Four Contaminants at Issue in the Wastewater

The FEIS provides an alternative reason for its conclusion that the four contaminants at issue in the wastewater (i.e., heptachlor, toluene, ethylbenzene, and tetrachloroethylene) will only have a "small" impact on the environment; namely, "[b]ecause of the relatively low concentrations of contaminants[,] the impacts of upward migration, if it occurred, would be expected to be minor." Ex. NRC-008A at 5-40. In support of the FEIS's conclusion, witnesses from the NRC Staff and FPL testified that the concentration of each of the four contaminants is below its EPA MCL (or primary drinking water standard), so even if the wastewater were to migrate through the Middle Confining Unit to the USDW in the Upper Floridan Aquifer, its impact would be "small." See Ex. NRC-002-R2 at 33–35; Ex. FPL-004 at 5–6. Joint Intervenors dispute the FEIS's conclusion, arguing that the EPA MCLGs (which are set at zero for both heptachlor and tetrchloroethylene) "should have been used to determine whether the environmental impact of the [contaminants] would be 'small.'" Ex. INT-022 at 17.[40]

We disagree. As discussed below, based on the expert testimony of NRC Staff witness, Dr. Miracle, and FPL witness, Dr. Teaf, we conclude that the appropriate standards to apply here are the EPA MCLs, not the EPA MCLGs.

Three witnesses testified on the appropriate drinking water standard that should be applied in determining the potential risks posed by the four contaminants: (1) for the NRC Staff, Dr. Miracle, who has a doctorate in the field of molecular immunology, and who has broad

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[40] As stated supra Part II.C, the EPA MCLGs for ethylbenzene and toluene are the same as the EPA MCLs for those contaminants. Because the concentrations of those contaminants in the wastewater are well below their respective MCLs (and hence well below their MCLGs), their impact on the environment would be "small" even as measured by the standard advocated by Joint Intervenors. In this respect, Joint Intervenors' witness, Mr. Quarles, did not dispute that the concentrations of ethylbenzene and toluene in the wastewater would pose "no known or anticipated adverse effect" to human health if injected directly into a drinking water source. See Tr. at 806–08.

experience in environmental toxicology, see Ex. NRC-003 at 1; Tr. at 804; (2) for FPL, Dr. Teaf, who has a doctorate in the field of toxicology, and who has broad experience in biomedical and toxicological research, see Ex. FPL-004 at 1; and (3) for Joint Intervenors, Mr. Quarles, who has a B.S. in Environmental Engineering Technology, is a licensed geologist, and who has broad experience in the field of investigating accidental releases of environmental pollutants and evaluating the risks associated with such releases. See Ex. INT-001 at 1; Tr. at 804–05.

Based on the education, experience, and written and oral testimony of Dr. Miracle and Dr. Teaf, we have no difficulty finding that their knowledge and expertise in the field of environmental toxicology far exceeds that of Mr. Quarles. For this reason, we credit their testimony regarding the appropriate standard that should be applied in determining the potential risks posed by the four contaminants.

Dr. Miracle and Dr. Teaf both agreed that "qualified professionals in the field of toxicology would typically use MCLs and not the MCLGs to assess environmental impacts from [the four contaminants at issue in this case]." Tr. at 810–11; see also Ex. FPL-062 at 5–6. They further attested—as did Joint Intervenors' witness, Mr. Quarles—that they were unaware of any injection well system in the United States that uses EPA MCLGs, as opposed to EPA MCLs, as the regulatory standard for assessing environmental impacts. See Tr. at 840. Dr. Teaf explained:

> The [EPA] has developed [MCLs] for the four constituents at issue in this case (and numerous other substances) in drinking water. Those drinking water standards were developed under the Safe Drinking Water Act and the National Primary Drinking Water Regulations applicable to public water systems. Primary standards protect human health by limiting levels of contaminants in public drinking water. Concentrations of the four constituents equal to or less than MCL standards are considered safe for consumption in drinking water.

Ex. FPL-062 at 2 (internal citations omitted); see also id. at 3, 5; Tr. at 810–11. Significantly, the record evidence firmly supports a conclusion that a contaminant injected into drinking water at a concentration below its EPA MCL will not have an environmental impact greater than small.

See Tr. at 843-44; see also Ex FPL-062 at 5 (Dr. Teaf testifies that the fact that the four contaminants "exist at concentrations below their respective [EPA MCLs], and thus would be permitted in any federally regulated drinking water supply, represents the functional definition of a 'small' impact.").[41]

Based on our review of the record, and aided by the persuasive testimony of Dr. Miracle and Dr. Teaf, we conclude that the EPA MCL is the appropriate standard for assessing the environmental impact of a contaminant, and that if a contaminant's concentration is below its EPA MCL, its environmental impact will be small. This conclusion permits us to construct the following syllogism, which demonstrates that the four contaminants at issue in this case will have a small environmental impact if they migrate to the Upper Floridan Aquifer: (1) a contaminant that is discharged into a USDW will have a small environmental impact if its concentration is below its EPA MCL; (2) the concentrations of heptachlor, toluene, ethylbenzene, and tetrachloroethylene in the wastewater are below their respective EPA MCLs;[42] and accordingly (3) these four contaminants will have a small environmental impact on the USDW if the wastewater were to migrate to the Upper Floridan Aquifer.

Joint Intervenors' witness, Mr. Quarles, nevertheless argued that tetrachloroethylene poses an undue risk to the USDW because its concentration in FPL's injected wastewater—0.00359 mg/L—exceeds its Florida-prescribed MCL, which is 0.003 mg/L. See Ex. INT-023, Pre-filed Rebuttal Testimony of Mark A. Quarles Regarding Joint Intervenors' Contention 2.1 at 14 (undated); supra note 15. We reject this argument for three reasons. First, as explained

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[41] Accord, e.g., Ex. FPL-004 at 13 (Dr. Teaf testifies that a contaminant with a concentration less than its EPA MCL "would not pose a health risk to the public even if directly injected into the drinking water."); Ex. NRC-002-R2 at 16 (Dr. Miracle testifies that a contaminant in drinking water with a concentration less than its EPA MCL "is protective of human health" and will have "no known health effects.").

[42] As stated supra Part II.C, the parties stipulated that the concentrations listed in FEIS Table 3-5 for the four contaminants at issue are "conservative and reliable." Ex. FPL-064 at 5. The concentration of each is below its EPA MCL. See supra note 15 and accompanying text.

above, we find that the EPA MCL (which is 0.005 mg/L for tetrachloroethylene) is the appropriate standard for determining the environmental impact of tetrachloroethylene. Second, FPL witness, Dr. Teaf, convincingly testified that the "small" difference between the concentration of tetrachloroethylene in the wastewater and the Florida MCL "would have an insignificant impact on public health." Ex. FPL-004 at 14. Third, as Dr. Teaf explained, Florida does not apply its MCLs myopically when considering permit applications for deep injection wells; rather, in determining the environmental impact of a contaminant, Florida takes into account "all kinds of considerations," including "[f]ate in transport, injection concentration, injection volumes, well construction, [and] hydrogeology." Tr. at 819–20.[43] And insofar as Florida granted FPL a permit to convert EW-1 from an exploratory well to an injection well, <u>see</u> Ex. FPL-002 at 4, it may reasonably be inferred that Florida—like the NRC Staff—concluded that the environmental impact of tetrachloroethylene will be small.[44]

In sum, this Board finds that a preponderance of the evidence supports the FEIS's conclusion that, even if the wastewater were to migrate to the Upper Floridan Aquifer, the

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[43] Dr. Teaf provided a further description of the type of analysis Florida used in determining the potential environmental impact of tetrachloroethylene in this case:

> I literally cannot imagine, based on my 35 years of experience, that the State of Florida would say that you can't inject water, which is 19 percent above the state drinking water standard, 3,000 feet down into the water zone under the assumption that it could magically make its way to a drinking water source at the surface, even understanding that the drinking water source is too saline to use as it is, and would have to undergo further treatment beyond that. Those are the kinds of safeguards [Florida] would be looking for.

Tr. at 820.

[44] Mr. Quarles also asserted that because heptachlor and tetrachloroethylene are possible human carcinogens, they ought not—in his opinion—be introduced into the environment at levels above their EPA MCLGs of zero. <u>See</u> Ex. INT-022 at 18. But Mr. Quarles' opinion fails to take into account that the EPA, in developing MCLs, considers a contaminant's potential carcinogenic effect in determining a value that is adequately protective of human health. <u>See</u> Tr. at 813–14, 839–40.

environmental impact of the four contaminants on the USDW would be small. Our finding is fortified by the fact that, as the FEIS states, by the time FPL's injected wastewater reached the Upper Floridan Aquifer, the concentrations of the four contaminants would likely be substantially lower than the values in Table 3-5. See Ex. NRC-008A at 5-21, 5-39 to 5-41.[45] In this regard, we credit the testimony of NRC Staff witnesses, Mr. Barnhurst and Mr. Thorne, and FPL witness, Mr. Jacobs, that the concentrations of the four contaminants listed in Table 3-5 will be further reduced as a result of (1) dilution that may occur while the wastewater is stored in the makeup water reservoir; (2) volatilization of toluene, ethylbenzene, and tetrachloroethylene that will occur when the wastewater is cycled through the cooling towers; (3) chemical hydrolysis and photo-degradation of heptachlor that will occur in the cooling towers; (4) dilution that may occur while the wastewater is stored in the blowdown sump; and (5) dilution that will occur when the wastewater is injected into the Boulder Zone. See Ex. NRC-002-R2 at 33–35; Tr. at 857–63; see also Ex. FPL-004 at 14–15; Ex. NRC-008A at 5-21, 5-40 to 5-41.[46]

VI. CONCLUSIONS OF LAW

For the foregoing reasons, we conclude that the NRC Staff took the requisite "hard look" under NEPA in assessing the environmental consequences of injecting wastewater from proposed Units 6 and 7 into the Boulder Zone underlying the Turkey Point site. The FEIS

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[45] Based on fate transport models, the FEIS declares that the concentration of, for example, tetrachloroethylene would be reduced by 95 to 100 percent by the time it migrated to the USDW. See Ex. NRC-008A at 5-40 to 5-41. Pursuant to these models, the "final concentrations [of the contaminants in the wastewater] expected at the USDW . . . would also be so low as to be undetectable." Id. at 5-41.

[46] Notably, the FEIS states that the high-level disinfectant wastewater treatment process that was recently installed at the SDWTP, see Ex NRC-008A at 5-21; see also supra Part II.A, may also contribute to reducing the concentrations of the contaminants below the values reported in Table 3-5. See Ex. NRC-008A at 5-21; id. at 3-39, tbl. 3-5 n.(b). Moreover, according to the FEIS, EPA considers the high-level disinfectant treatment process to be "as effective as confinement of fluids in protecting USDWs from contaminants in wastewater," because "the quality of the wastewater has been treated to a level that is no longer a threat to USDWs." Id. at 5-20 to 5-21 (quoting Ex. NRC-035, EPA, Protecting Drinking Water Through Underground Injection Controls at 16 (2012)).

correctly determines that the environmental consequences of such wastewater injections will be "small," because (1) the wastewater that FPL injects into the Boulder Zone is unlikely to migrate to the Upper Floridan Aquifer; and (2) even if the wastewater were to reach the Upper Floridan Aquifer, the concentration of each challenged contaminant is below its EPA MCL and, accordingly, its environmental impact would be no greater than small.

VII. ORDER

For the foregoing reasons, Joint Intervenors' Contention 2.1 is resolved in favor of the NRC Staff. This initial decision will constitute the final action of the Commission on the contested matter 120 days after its issuance, unless (1) a party files a petition for Commission review within 25 days after service of this initial decision; or (2) the Commission directs otherwise. See 10 C.F.R. §§ 2.341(b), 2.1210(a), 2.1212. Within 25 days after service of a petition for Commission review, parties to the proceeding may file an answer supporting or opposing Commission review. See id. § 2.341(b)(3).[47] A party who seeks judicial review of this decision must first seek Commission review, unless otherwise authorized by law. See id. § 2.1212.

It is so ORDERED.

THE ATOMIC SAFETY
AND LICENSING BOARD

/RA/

E. Roy Hawkens, Chairman
ADMINISTRATIVE JUDGE

/RA/

Dr. Michael F. Kennedy
ADMINISTRATIVE JUDGE

/RA/

Dr. William C. Burnett
ADMINISTRATIVE JUDGE

Rockville, Maryland
July 10, 2017

[47] Any petition for Commission review, and any answer, shall conform to the requirements of 10 C.F.R. § 2.341(b)(2)–(3).

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
FLORIDA POWER & LIGHT COMPANY	)	Docket Nos. 52-040 and 52-041-COL
(Juno Beach, Florida)	)	
	)	
(Turkey Point, Units 6 & 7)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of the **INITIAL DECISION (LBP-17-05)** have been served upon the following persons by Electronic Information Exchange.

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[Original signed by Brian Newell]
Office of the Secretary of the Commission

Dated at Rockville, Maryland,
this 10th day of July, 2017