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NUCLEAR REGULATORY COMMISSION

Title:	Florida Power & Light Company Hearing
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Location:	Homestead, Florida
Date:	May 2, 2017
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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ATOMIC SAFETY AND LICENSING BOARD PANEL

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HEARING

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

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Tuesday, May 2, 2017

Council Chambers
Homestead City Hall
100 Civic Court
Homestead, Florida

BEFORE:

E. ROY HAWKENS, Chair

DR. MICHAEL F. KENNEDY, Administrative Judge

DR. WILLIAM C. BURNETT, Administrative Judge

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I N D E X

Exhibit	Marked	Received
INT-005-R Third Affidavit of Mark A. Quarles (Feb. 2, 2016) (filed in response to FPL's Statement of Material Facts As To Which No Genuine Issue Exists, in support of FPL's Motion for Summary Disposition of Intervenors' Amended Contention 2.1 (Dec. 15, 2015)) (redlined strikeout of INT-005)	603	603
INT-006 Kevin J. Cunningham, Cameron Walker, & Richard L. Westcott, *Near-Surface, Marine Seismic-Reflection Data Define Potential Hydrogeologic Confinement Bypass in the Carbonate Floridan Aquifer System, Southeastern Florida*, SEG Technical Program Expanded Abstracts 2012, (2012) (cited in the FEIS as 2012-TN4576)	603	603

<u>Exhibit</u>	<u>Marked</u>	<u>Received</u>
INT-007 Kevin J. Cunningham, *Integrating Seismic-Reflection and Sequence-Stratigraphic Methods to Characterize the Hydrogeology of the Floridan Aquifer System in Southeast Florida*, U.S. Geological Survey Open File Report 2013-1181, (2013)(cited in the FEIS as 2013-TN4573)	603	603
INT-008 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*, U.S. Geological Survey Open-File Report 2014-1136 (2014) (cited in the FEIS as 2014-TN4051)	603	603

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INT-009 Kevin J. Cunningham, *Seismic-Sequence Stratigraphy and Geologic Structure of the Floridan Aquifer System Near "Boulder Zone" Deep Wells in Miami-Dade County, Florida*, U.S. Geological Survey Scientific Investigations Report 2015-5013 (2015)(cited in the FEIS as 2015-TN-4574)	603	603
INT-010A McNabb Hydrogeologic Consulting, Inc., *Report on the Construction and Testing of Class V Exploratory Well EW-1 at the Florida Power and Light Company Turkey Point Units 6 & 7* (2012) (cited in the FEIS as FPL 2012-TN1577) (originally filed as pages 1-150 of Exhibit INT-010)	603	603

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INT-010B McNabb Hydrogeologic Consulting, Inc., *Report on the Construction and Testing of Class V Exploratory Well EW-1 at the Florida Power and Light Company Turkey Point Units 6 & 7* (2012) (cited in the FEIS as FPL 2012-TN1577) (originally filed as pages 151-225 of Exhibit INT-010)	603	603
INT-010C McNabb Hydrogeologic Consulting, Inc., *Report on the Construction and Testing of Class V Exploratory Well EW-1 at the Florida Power and Light Company Turkey Point Units 6 & 7* (2012) (cited in the FEIS as FPL 2012-TN1577) (originally filed as pages 226-350 of Exhibit INT-010)	603	603

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INT-010D McNabb Hydrogeologic Consulting, Inc., *Report on the Construction and Testing of Class V Exploratory Well EW-1 at the Florida Power and Light Company Turkey Point Units 6 & 7* (2012) (cited in the FEIS as FPL 2012-TN1577) (originally filed as pages 351-450 of Exhibit INT-010)	603	603
INT-010E McNabb Hydrogeologic Consulting, Inc., *Report on the Construction and Testing of Class V Exploratory Well EW-1 at the Florida Power and Light Company Turkey Point Units 6 & 7* (2012) (cited in the FEIS as FPL 2012-TN1577) (originally filed as pages 451-471 of Exhibit INT-010)	603	603

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INT-011 Ronald Reese & Emily Richardson, *Scientific Investigations Report 2007-5207, Synthesis of the Hydrogeologic Framework of the Floridan Aquifer System and Delineation of the Major Avon Park Permeable Zone in Central and Southern Florida*, U.S. Geological Survey Scientific Investigations Report 2007-5207 (2008)	603	603
INT-012 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*, Hydrogeology Journal, 18(4): 1027-1042 (2009)	603	603
INT-013 Robert C. Starr, Timothy S. Green, & Laurence C. Hull, *Evaluation of*		

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INT-014
Robert G. Maliva et al., *Vertical Migration of Municipal Wastewater in Deep Injection Well Systems, South Florida, USA* (2007) 603 603

INT-015A
U.S. EPA Office of Water, *Relative Risk Assessment of Management Options for Treated Wastewater in South Florida*, 4-12 (2003) (originally filed as pages 1-100 of Exhibit INT-015) 603 603

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INT-015B U.S. EPA Office of Water, *Relative Risk Assessment of Management Options for Treated Wastewater in South Florida*, 4-12 (2003) (originally filed as pages 101-200 of Exhibit INT-015)	603	603
INT-015C U.S. EPA Office of Water, *Relative Risk Assessment of Management Options for Treated Wastewater in South Florida*, 4-12 (2003) (originally filed as pages 201-300 of Exhibit INT-015)	603	603
INT-015D U.S. EPA Office of Water, *Relative Risk Assessment of Management Options for Treated Wastewater in South Florida*, 4-12 (2003) (originally filed as pages 301-388 of Exhibit INT-015)	603	603

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INT-016 ATSDR, *Division of Toxicology and Environmental Medicine ToxFAQs* (compiled for ethylbenzene (2007), tetrachloroethylene (2014), and heptachlor (2007))	603	603
INT-017 Alyssa M. Dausman, Christian Langevin, Michael C. Sukop, & Virginia Walsh, *Saltwater/Freshwater Interface Movement in Response to Deep-Well Injection in a Coastal Aquifer*, Proceedings of the 20th Salt Water Intrusion Meeting, June 23-27, Naples, Florida (2008)	603	603
INT-018 Frederick Bloetscher et al., *Comparative Assessment of Municipal Wastewater Disposal Methods in Southeast Florida*, Water		

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INT-019 Florida Department of Environmental Protection, Miami-Dade South District Wastewater Treatment Plant, Domestic Wastewater Facility Permit, Permit Number FLA042137 (Dec. 10, 2012)	603	603
INT-020 Florida Department of Environmental Protection, Regional Water Supply Planning, 2015 Annual Report	603	603
INT-021 Notice of Final Rule, National Primary Drinking Water Regulations; Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants, 52 Fed. Reg. 25,690-91 (July 8, 1987)	603	603

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INT-022 Prefiled Initial Testimony of Mark A. Quarles Regarding Joint Intervenors' Contention 2.1	603	603
INT-023 Pre-filed Rebuttal Testimony of Mark A. Quarles Regarding Joint Intervenors' Contention 2.1	603	603
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FPL-005B Report on the Construction and Testing of Class V Exploratory Well EW-1 at the Florida Power & Light Company Turkey Point Units 6 & 7 (pages 245 to 471)	604	604

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FPL-005C Report on the Construction and Testing of Class V Exploratory Well EW-1 at the Florida Power & Light Company Turkey Point Units 6 & 7 (pages 472 to 560)	604	604
FPL-006A AECOM (2009). Engineering Report on the Construction & Testing of Deep injection Well IW-1 and Fuel Zone Monitoring Well MW-1, Robert Dean WTP, Florida City, FL (pages 1 to 61)	604	604
FPL-006B AECOM (2009). Engineering Report on the Construction & Testing of Deep injection Well IW-1 and Fuel Zone Monitoring Well MW-1, Robert Dean WTP, Florida City, FL (pages 62 to 160)	604	604

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FPL-006C AECOM (2009). Engineering Report on the Construction & Testing of Deep injection Well IW-1 and Fuel Zone Monitoring Well MW-1, Robert Dean WTP, Florida City, FL (pages 161 to 257)	604	604
FPL-006D AECOM (2009). Engineering Report on the Construction & Testing of Deep injection Well IW-1 and Fuel Zone Monitoring Well MW-1, Robert Dean WTP, Florida City, FL (pages 258 to 338)	604	604
FPL-006E AECOM (2009). Engineering Report on the Construction & Testing of Deep injection Well IW-1 and Fuel Zone Monitoring Well MW-1, Robert Dean WTP, Florida City, FL (pages 339 to 361)	604	604

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FPL-007 Cunningham, et al (2012) Near-surface, marine seismic-reflection data define potential hydrogeologic confinement bypass in the carbonate Floridan aquifer system, southeastern Florida	604	604
FPL-008A Cunningham (2015). Seismic-sequence stratigraphy and geologic structure of the Floridan aquifer system near "Boulder Zone" deep wells in Miami-Dade (pages 1 to 40)	604	604

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FPL-008B Cunningham (2015). Seismic-sequence stratigraphy and geologic structure of the Floridan aquifer system near "Boulder Zone" deep wells in Miami-Dade (page 41)	604	604
FPL-008C Cunningham (2015). Seismic-sequence stratigraphy and geologic structure of the Floridan aquifer system near "Boulder Zone" deep wells in Miami-Dade (page 43)	604	604
FPL-009 Dausman, et al (2010). Hypothesis testing of buoyant plume migration using a highly parameterized variable-density groundwater model at a site in Florida, USA. Hydrogeology Journal,18(1), 147-160	604	604

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FPL-011 Duncan, et al (1994). Geological framework of the Lower Floridan Aquifer System, St. Lucie, Martin and Palm Beach Counties: Report prepared by the Florida Geological Survey for the FDEP, 126 p	604	604
FPL-012 Englehardt, et al (2001). Comparative Assessment of Human and Ecological Impacts for Municipal Wastewater Disposal Methods in Southeast Florida: Deep Wells, Ocean Outfalls, and Canal Discharges	604	604

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FPL-013 Maliva, et al (2007). Vertical Migration Of Municipal Wastewater In Deep Injection Well Systems, South Florida, U.S.A.: Hydrogeology Journal, v. 15, p. 1387-1396	604	604
FPL-014 Maliva & Walker (1998). Hydrogeology of deep-well disposal of liquid wastes in southwestern Florida, U.S.A.: Hydrogeology Journal, v. 6, p. 538-548	604	604
FPL-015 Maliva & Walker (2000). Deep well injection in South Florida-the vertical confinement experience: Proceedings of the 2000 Ground Water Protection Council Annual Forum, p. 63-73	604	604

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FPL-016 Metz (2016). Discharge, water temperature, and water quality of Warm Mineral Springs, Sarasota County, Florida-A retrospective analysis: U.S.G.S. Open-File Report 2016-1166, 31 p	604	604
FPL-017 Miami-Dade Water and Sewer Department (2014) 20-year water supply facilities work plan (2014 - 2033) Support Data (November 2014)	604	604
FPL-018 Miller (1986). Hydrogeologic framework of the Floridan aquifer system in Florida and in parts of Georgia, Alabama, and South Carolina. U.S.G.S. Professional Paper 1403-B	604	604

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FPL-019B Miller (1990). Ground Water Atlas of the United States. Alabama, Florida, Georgia, and South Carolina. U.S. Geological Survey Report HA 730-G (pages 16 to 30)	604	604
FPL-020 Missimer & Maliva (2004). Tectonically induced fracturing, folding, and groundwater flow in South Florida. Gulf Coast Association Geological Societies Transactions, 54:6043-459	604	604

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FPL-021 Mitchell-Tapping, et al (1999). Mud Hole: a unique warm-water submarine spring, located offshore southwestern Florida. Transactions Gulf Coast Association of Geological Societies, v.49, p. 370-383	604	604
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FPL-026 Starr, et al (2001). Evaluation of Confining Layer Integrity Beneath the South District Wastewater Treatment Plant, Miami-Dade Water and Sewer Department, Dade County, Florida. INEEL	604	604

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FPL-028 Walsh & Price (2010). Determination of vertical and horizontal pathways of injected fresh wastewater into a deep saline aquifer (Florida, USA) using natural chemical tracers	604	604
FPL-029 McNeil (2000). A Review of Upward Migration of Effluent Related to Subsurface Injection at Miami-Dade Water and Sewer South District Plant. Report prepared for the Sierra Club	604	604

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FPL-031 ATSDR (Agency for Toxic Substances and Disease Registry) 2014a. Draft Toxicological Profile for Tetrachloroethylene. U.S. Department of Health and Human Services. October 2014	604	604
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FPL-052 KSA (KSA Environmental Laboratory, Inc.). 2007. Annual Plant Sampling, Miami Dade Water/Sewer. April 13, 2007	604	604
FPL-053 FDEP (Florida Department of Environmental Protection). 2015. Chapter 62-550. Drinking Water Standards, Monitoring, and Reporting. July 7, 2015	604	604

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FPL-055 Xenco (Xenco Laboratories). 2010. Annual Priority Pollutants. Analytical Report 363251 for Miami Dade Water & Sewer. March 17, 2010	604	604
FPL-056 Xenco (Xenco Laboratories). 2011. Annual Priority Pollutants. Analytical Report 407304 for Miami Dade Water & Sewer. March 27, 2011	604	604
FPL-057 USEPA (U.S. Environmental Protection Agency). 2016b. How EPA Regulates Drinking Water Contaminants. May 11, 2016	604	604

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FPL-059 USEPA (U.S. Environmental Protection Agency). 1992. National Oil and Hazardous Substances Pollution Contingency Plan	604	604
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FPL-063 Walsh, V. M. (2012). Geochemical determination of the fate and transport of injected fresh wastewater to a deep saline aquifer. Ph.D. Dissertation, Florida Internal University, Miami, Florida	604	604
FPL-064 Joint List of Undisputed Facts	604	604
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NRC-008D NUREG-2176, Vol. 3, Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7, Appendices E (Final Report) (Oct. 2016)	605	605
NRC-010 EPA 816-R-03-010, Relative Risk Assessment of Management Options for Treated Wastewater in South Florida (Apr. 2003)(TN4759)	605	605

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NRC-011 Bloetscher, F., J.D. Englehardt, D.A. Chin, J.B. Rose, G. Tchobanoglous, V.P. Amy, and S. Gokgoz. "Comparative Assessment of Municipal Wastewater Disposal Methods in Southeast Florida." *Water Environment Federation* 77(5):480-490, Alexandria, Virginia. (2005)(TN4756). FULL TEXT COPYRIGHT	605	605
NRC-012 Dausman, A.M., C. Langevin, M.C. Sukop, and V. Walsh. "Saltwater/Freshwater Interface Movement in Response to Deep-Well Injection in a Coastal Aquifer." In *Proceedings of the 20th Salt Water Intrusion Meeting, June 23-27, 2008, Naples, Florida*. (2008)(TN4757)	605	605

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NRC-013 Florida Keys Aqueduct Authority. "Where Does Our Water Come From?" (2014)(TN3649)	605	605
NRC-014 Reese, R.S. U.S. Geological Survey Water-Resources Investigations Report 94-4010, *Hydrogeology and the Distribution and Origin of Salinity in the Floridan Aquifer System, Southeastern Florida*. Tallahassee, Florida (1994)(TN1439)	605	605
NRC-017 USGS, Impact of Anthropogenic Development on Coastal Ground-Water Hydrology in Southeastern Florida, 1900-2000 (2005)(TN110)	605	605
NRC-018 Meyer, F.W., U.S. Geological Survey Professional Paper 1403-G,		

Hydrogeology, Ground-Water Movement, and Subsurface Storage in the Florida Aquifer System in Southern Florida. (1989)(TN2255)	605	605
NRC-019 Fla. Admin. Code 62-528 Underground Injection Control (2010)	605	605
NRC-020 L-2012-089, Letter from William Maher to NRC RE: Submittal of Underground Injection Control Exploratory Well-Final Casting Setting Depth Recommendation (March 7, 2012)(TN1264)	605	605
NRC-021 Underground Injection Control Program-Revision to the Federal Underground Injection Control Requirements for Class I Municipal Disposal Wells in Florida, 70 Fed. Reg. 70,513, 70,532 (Nov. 22, 2005)	605	605

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NRC-023 Miami-Dade Water and Sewer Department Comprehensive Annual Financial Report (Sept. 30, 2014)(TN4758)	605	605
NRC-025 Fla. Admin. Code 62-600 (2012)(TN1268)	605	605
NRC-026 John Bell et al, "Stripping of Volatile Organic Compounds at Full-Scale Municipal Wastewater Treatment Plants." *Water Environment Research, Vol 65, No. 6*, at 708-716 (Oct.1993)(Melcer et al,		

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NRC-073 Affidavit of Alicia Williamson-Dickerson	605	605
NRC-074 Affidavit of Ann L. Miracle	605	605
NRC-075 Affidavit of Daniel O. Barnhurst	605	605
NRC-076 Affidavit of Paul D. Thorne	605	605

P R O C E E D I N G S

9:31 a.m.

CHAIRMAN HAWKENS: Good morning. Please be seated. We can go on the record, Dylan.

Good morning. This morning we're conducting a hearing in the case entitled Florida Power & Light Company, Turkey Point Units 6 and 7, Docket No. 52-040-COL and 52-041-COL.

My name is Roy Hawkens. I'm the Chairman of this licensing board. I'm legally trained. On my right is Judge Mike Kennedy, who has his doctorate in nuclear engineering. On my left is Bill Burnett, who has his doctorate in environmental science.

Would counsel for the parties please introduce themselves starting with Joint Intervenors?

MS. CURRAN: Good morning, Judge Hawkens, members of the licensing board. My name is Diane Curran. I am here on behalf of the Joint Intervenors.

With me today are, to my left, our expert, Mark Quarles, Caroline Reiser, a fellow at Turner Environmental Law Clinic, behind me, Mindy Goldstein, Executive Director of the Turner Environmental Law Clinic, Jason Totoiu, Executive Director of the Everglades Law Center, and behind them, eight students from the Turner Environmental Law Clinic.

CHAIRMAN HAWKENS: Good morning and welcome.

MR. ARANGO: Jose Arango, on behalf of the Village of Pinecrest.

MR. ALBAN: Good morning. Xavier Alban, on behalf of the City of Miami, and to my left is my colleague, Kerri McNulty, also with the City of Miami.

CHAIRMAN HAWKENS: Good. Thank you.

MR. LEPRE: Good morning. I'm Mike Lepre for the Applicant, FPL. I'm with the law firm of Pillsbury, Winthrop, Shaw, Pittman.

To my right is Anne Leidich, an attorney with our firm. And also in the hearing room today from FPL are several members of their in-house legal team, as well as their new nuclear project team, including the senior licensing director for the project, Bill Maher.

CHAIRMAN HAWKENS: Thank you.

MR. LEPRE: Thank you.

MS. WRIGHT: Good morning. I'm --

CHAIRMAN HAWKENS: -- must be Staff.

MS. WRIGHT: I'm Megan Wright, counsel for NRC Staff. Behind me is Bob Weisman and also Maxine Segarnick.

CHAIRMAN HAWKENS: Welcome.

MS. WRIGHT: Thank you.

CHAIRMAN HAWKENS: At the outset, I'd like to introduce several other members of the Atomic Safety and Licensing Board panel who are assisting this licensing board.

And I'd encourage counsel, and if they have any questions or need any assistance during the pendency of this hearing, please feel free to approach them.

First, our law clerks, Ms. Jen Scro, Kim Hsu, and Lindsay Simmons, our IT expert, Andy Welkie, and the licensing board's strong right arm is Ms. Karen Valloch in the back.

The issue that we're litigating in this case is an environmental contention brought by Joint Intervenors that we refer to as Contention 2.1. The contention asserts that FPL's application for combined licenses for Turkey Point Units 6 and 7 should not be granted because the Final Environmental Impact Statement prepared the Nuclear Regulatory Commission for the project is deficient.

Contention 2.1 alleges "the Final Environmental Impact Statement or FEIS is deficient in concluding that the environmental impacts for FPL's proposed deep injection wells will be small. The chemicals, ethylbenzene, heptachlor, tetrachloroethylene, and toluene, in the wastewater injections at concentrations listed in the FEIS Table 3-5 may adversely impact the groundwater should they migrate from the Boulder Zone to the Upper Floridan Aquifer."

Today's hearing is what we call a Subpart L hearing because it's governed by the procedures in Title 10 of the Code of Federal Regulations, Part 2, Subpart L.

Pursuant to those procedures, this board has already received from the parties several hundred pages of written testimony, several thousand pages of pre-filed exhibits, and written briefs and responses.

The licensing board has reviewed the written testimony and the exhibits, which, in addition to the testimony we'll hear today, will comprise the evidence we'll use in deciding this case.

The main purpose of today's hearing is to give the board an opportunity to question the parties' witnesses. In this respect, today's hearing will differ from a typical courtroom proceeding you may be familiar with where counsel for the parties have the primary responsibility for questioning witnesses.

The parties have provided this board with a list of proposed questions that they've requested the board to ask. But deciding what questions to ask is a matter that's vested in the discretion of the licensing board.

The questions we ask today do not necessarily mean we favor or disfavor a party's position, but they reflect that the pre-filed exhibits we've reviewed have raised questions we would like to explore in order to fully understand the record.

For the benefit of the attending audience and as a reminder to counsel, I'll summarize the procedural steps we'll be following at this hearing.

At the outset, we'll swear in the parties' witnesses. Next, we'll admit the parties' pre-filed exhibits into evidence. Third, we'll hear opening statements from counsel. And, fourth, the board will question the parties' witnesses.

For efficiency, the witnesses will sit on five discrete panels. Each panel will answer questions relating to a particular technical topic. The five topics are as follows.

The first topic will explore the hydrogeologic properties of the confining unit that separates the Boulder Zone from the Upper Floridan Aquifer and whether that confining unit is likely to prevent wastewater injected into the Boulder Zone from migrating to the Upper Floridan Aquifer.

The second topic is whether the deep injection wells that will be used at the Turkey Point facility are likely to leak and introduce wastewater into the Upper Floridan Aquifer.

The third topic is whether FPL's monitoring systems would likely detect leaking or migrating wastewater before it reaches the Upper Floridan Aquifer.

The fourth topic is the impact on human health of the four contaminants if the wastewater migrates to the Upper Floridan Aquifer at concentrations listed in the FEIS.

And the fifth and final topic is whether the concentration of the contaminants could change after they're discharged into the Boulder Zone.

After we've completed questioning all five panels, counsel for the parties and for the municipalities will have the opportunity to submit proposed questions they'd like us to consider asking before the testimony -- excuse me. They'll have the opportunity to submit proposed questions they'd like us to consider based on the testimony that is raised in today's or tomorrow's hearing.

Finally, after all the questioning is complete, the counsel will have the opportunity to present closing statements.

After the opening statements, we will take a brief recess in order to sit the first panel.

Throughout the hearing today and if we go into tomorrow, and I think it's likely we may go into tomorrow morning, if counsel or if witnesses during the questioning of the panels would like to take a brief recess for any reason, please don't hesitate to bring that to our attention.

We'll also take a recess for lunch today at an appropriate time, probably after we complete questioning panel 1 or at a very advanced stage of questioning panel 1.

This facility closes at 5:00, which means we'll need to adjourn by about 4:40 to give everybody the opportunity to pack up so we can exit the facility at 5:00.

As I mentioned earlier, if we do not finish the hearing today, we will reconvene tomorrow morning at a time we will agree upon later this afternoon if we need to.

At this point, if the counsel for the parties or the participants have any questions, let me start with the parties. Ms. Curran?

MS. CURRAN: Judge Hawkens, I do have one question which is, if we do stay overnight -- maybe this is a question that will come up later -- can we leave our written materials -- we have binders full of testimony -- in the hearing room?

CHAIRMAN HAWKENS: I'll find that out and get back to you before lunch, Ms. Curran. Mr. Lepre, any questions?

MR. LEPRE: No, Your Honor.

CHAIRMAN HAWKENS: Ms. Wright?

MS. WRIGHT: No, Your Honor.

CHAIRMAN HAWKENS: Municipalities?

MR. ARANGO: No, Your Honor.

CHAIRMAN HAWKENS: All right. Thank you. Would counsel, starting with Joint Intervenors, then FPL, and then the NRC Staff, please introduce their witnesses? And would each witness stand as your name is called and remain standing?

MS. CURRAN: Joint Intervenors present their expert witness, Mark E. Quarles.

MR. LEPRE: The FPL's witnesses are Dr. Robert Maliva, Dr. Christopher Teaf, Mr. Paul Jacobs, and Mr. David McNabb.

CHAIRMAN HAWKENS: Good morning. Ms.

Wright?

MS. WRIGHT: NRC Staff witnesses are Dan Barnhurst, Paul Thorne, Ann Miracle, and Alicia Williamson.

CHAIRMAN HAWKENS: Thank you. And it's Dr. Miracle, I understand? Yes. All right.

Would the witnesses please raise their right hand? Do you solemnly swear or affirm that all the statements you'll make in this hearing will be true and correct to the best of your knowledge and belief?

WITNESSES: I do.

CHAIRMAN HAWKENS: Would the record please reflect that the witnesses all answered in the affirmative?

You may be seated. And I'd remind you that you may be called upon at different times today in different panels and tomorrow as well to testify. Any time you do testify you will remain under oath or affirmation.

Next, we are going to identify the parties' pre-filed exhibits and admit those exhibits into evidence by records to the parties' exhibit lists.

And I will start with Joint Intervenors.

I'm referring to, Ms. Curran, your Joint Intervenors' exhibit list, which is a three-page document filed on April 13, 2017. It's titled "Final Resubmitted List of Exhibits for Joint Intervenors, Initial Written Statement of Position on Contention 2.1, and Pre-filed Testimony of Mark A. Quarles Regarding the Joint Intervenors Contention 2.1."

Did the document I just describe contain all the exhibits you wish to have admitted into this hearing?

MS. CURRAN: Yes, it does. Those are Exhibits INT-000-R through INT-023.

(Whereupon, the above-referred to documents were marked as INT-000-R through INT-023 for identification.)

CHAIRMAN HAWKENS: And that is inclusive. Did you get that, Court Reporter? Thank you.

This board admits into evidence all of the exhibits listed in this three-page document.

(Whereupon, the above-referred to documents were received into evidence as INT-000-R through INT-023.)

CHAIRMAN HAWKENS: And just for

clarification, Ms. Curran, the exhibit list I'm looking at had the title on it, but it did not have the exhibit number. It is properly, will be marked as INT-000-R. Is that correct?

MS. CURRAN: That's correct.

CHAIRMAN HAWKENS: All right. Thank you. I'm now referring to FPL's exhibit list, which is an eight-page document dated April 13, 2017. And it's marked with Exhibit No. FPL-000R2.

Mr. Lepre, does this document I just described contain all the documents you wish to have admitted into evidence?

MR. LEPRE: Yes, it does.

CHAIRMAN HAWKENS: Hearing no objections to the admission of these exhibits, the board admits into evidence all of the exhibits listed in this document, which consist of Exhibit Nos. FPL-000R2 through FPL-064 inclusive.

(Whereupon, the above-referred to documents were marked as FPL-000R2 through FPL-064 for identification and were received into evidence.)

CHAIRMAN HAWKENS: I'm now referring to the NRC Staff's exhibit list, which is a ten-page document dated April 14th and which is marked Exhibit No. NRC-001-R2.

Ms. Wright, does this document I just described contain all the exhibits you wish to have admitted into evidence?

MS. WRIGHT: Yes, Your Honor.

CHAIRMAN HAWKENS: Hearing no objections to the admission of these exhibits, the board admits into evidence all the exhibits listed in this exhibit list, which consist of Exhibits NRC-001-R2 through NRC-076 inclusive.

(Whereupon, the above-referred to documents were marked as NRC-001-R2 through NRC-076 for identification and were received into evidence.)

CHAIRMAN HAWKENS: Are there any matters that counsel wish to address before we proceed to the opening statements?

We'll now hear opening statements from the counsel. We'll hear them in the following order: first from Joint Intervenors, second from the Village of Pinecrest, third from the City of Miami, next the NRC Staff, and finally FPL.

Opening statements will not exceed ten

minutes. And if board members have questions, we'll endeavor to refrain from asking them until the end of your statements.

As I mentioned, opening statements should not exceed ten minutes. Counsel are not obligated to use the entire time.

Our law clerk will assist counsel keeping track of time by raising the amber sign when two minutes are left and the red sign when your time is expired. When you see the red sign, if you could endeavor to wrap things up as quickly as possible, we would be grateful.

Would the opening statement presenter for Joint Intervenors please come forward? Ms. Reiser, is that correct?

MS. REISER: Yes.

CHAIRMAN HAWKENS: Good morning.

MS. REISER: Good morning. May it please the board, my name is Caroline Reiser. And I'm the fellow with the Turner Environmental Law Clinic at Emory Law School.

I am here on behalf of Joint Intervenors, the National Parks Conservation Association, the Southern Alliance for Clean Energy, and local residents, Captain Dan Kipnis and Mark Oncavage.

With the support of our expert, Mark Quarles, who has extensive experience in wastewater disposal and contaminant investigations, Joint Intervenors have shown and will show further today that the U.S. Nuclear Regulatory Commission Staff have not produced an adequate Final Environmental Impact Statement for Turkey Point Units 6 and 7 nuclear power plant.

Specifically, NRC Staff fail to support their conclusions that, one, wastewater injected underground is extremely unlikely to migrate into an underground source of drinking water, or, two, if it did migrate, that the impacts would be small.

To reach its conclusions, NRC Staff stubbornly relies on outdated method of using a single well to analyze how likely wastewater is to migrate and ignores the demonstrated need to first conduct seismic reflection studies, a technology that is embraced and recommended by federal and local governments in this area and would provide more accurate and comprehensive data about how likely migration is to occur at the site.

NRC Staff can casually brush aside the toxic nature of the contaminants in the wastewater while insisting that high level disinfection, a technology meant to do something else, will ensure that the concentrations of the contaminants in the wastewater will remain low enough to drink.

Ignoring reality in the face of potentially grave environmental impacts is what the National Environmental Policy Act was meant to prevent.

NEPA requires agencies take a hard look at potential environmental impacts to ensure that information is carefully considered and actions are fully understood before they are taken so that decision makers can consider alternatives to those actions or ways to mitigate any significant environmental impacts of those actions.

NRC Staff's continuous failure over the past seven years to use reasonable and scientifically defensible technology to support their conclusions means that they have not taken the requisite hard look at these issues.

Pollution of potential drinking water supplies by wastewater injection is a serious and urgent concern in South Florida because of this area's extremely complex and unique geology and the known need for additional drinking water sources in this region in the near future.

The Turkey Point FEIS mocks NEPA's requirement of informed decision-making for an issue that has the potential to greatly impact future generations.

NRC Staff must either, one, support their conclusion that wastewater injected underground is extremely unlikely to migrate into an underground source of drinking water, or, if they are unable to do this, they have no choice but to acknowledge the uncertainty surrounding migration and conclude that impacts may be significant.

To first expand upon the issue of migration, there is a clear history of upward migration in South Florida. Time and again there have been unexpected vertical intrusions of wastewater into drinking water supplies of South Florida.

U.S. EPA has even stated that there is no way to be certain that water injected underground in this region will not migrate.

The only way to address this uncertainty is to use seismic reflection surveying, which can help locate geologic pathways that can transport injected wastewater into upper aquifers. By doing so, this technology provides the most comprehensive set of data available to explain how and why wastewater has migrated through layers of bedrock previously thought to be containing.

NRC Staff simply can't have taken the requisite hard look at migration without using seismic reflection surveying. In fact, government experts at the local and federal levels agree that there is an immediate need for the use of seismic reflection technology in Florida.

For example, right here the Miami-Dade Water and Sewer Department and the U.S. Geologic Survey have been using seismic reflection to test for the presence of geologic pathways such as fractures, faults, and karst features using seismic reflection.

The chief of the Water and Sewer Department's hydrogeology section, Dr. Virginia Walsh, even recommended all the way back in 2012 that seismic reflection be used for all future injection sites.

This is because seismic reflection could help identify if a site is suitable for underground injection at all, or it could optimize the injection of monitoring and injection wells in sites, in areas where no subsurface geologic pathways are found.

But even with all of the support for seismic reflection surveying, NRC Staff continue to offer no convincing reasons that they didn't use this effective and feasible technology.

They refuse to acknowledge the importance of this issue. They refuse to address the uncertainty regarding migration of injectate. And they refuse to investigate using the accepted method in South Florida, seismic reflection.

Instead, NRC Staff cling to an outdated method of drilling only a single test well to conclude that Turkey Point is somehow unlike many of the areas around the site and upward migration of wastewater is extremely unlikely to occur at this site.

But this single well cannot provide nearly enough information about the site specific characteristics of Turkey Point.

Without the use of seismic reflection surveying to understand where any wastewater injected at Turkey Point will end up, NRC Staff simply can't have taken the requisite hard look.

The second issue underlying our contention is that NRC Staff have also failed to adequately support their conclusion that if upward migration of wastewater were to occur, impacts from chemical constituents in that water would be small.

This conclusion is based on the incorrect assumption that there is any concentration of these contaminants that would be safe in drinking water.

But EPA says that there is no dose, meaning zero, that is considered safe for two of the contaminants at issue, tetrachloroethylene and heptachlor.

In fact, the level of tetrachloroethylene measured in the FEIS is above Florida's legal limit for drinking water. This alone establishes significance.

EPA in Florida set the drinking water limits so low for these contaminants because they are toxic to vulnerable populations and possibly carcinogenic.

The potential to introduce toxins into water that has been designated as a future drinking water source requires serious contemplation, because you run the risk of widespread and long-lasting contamination.

To resolve this problem, the NRC Staff now claim that high level disinfection technology installed at the South District Plant in 2013 has lowered the contaminant level more than originally reported.

However, this technology cannot be relied upon to serve the purpose of removing the four contaminants at issue today. High level disinfection is not designed to remove volatile organic compounds and semi-volatile organic compounds like the contaminants at issue.

Only circumstantial evidence provides NRC Staff any basis to rely on high level disinfection. But coincidence and happenstance are not sound footing for informed decision-making. NRC Staff make this unfounded argument of last resort, but it is not enough to meet NEPA's burden.

Therefore, NRC Staff have failed to provide adequate support that the environmental impacts would be small if wastewater containing the contaminants were to migrate into an underground source of drinking water.

Informed decision-making done now protects generations in the future. The NRC Staff have failed to take the hard look at upward migration of wastewater or the impacts of the chemical constituents. And, therefore, they have not made an informed decision.

The NRC Staff must either, one, support their conclusion that upward migration is extremely unlikely to occur using the best available and feasible science, or, two, they have no choice but to conclude that there is uncertainty regarding migration and that the impacts may be significant.

We respectfully request that the board find that the FEIS for Turkey Point is inadequate to comply with NEPA or to justify licensing Turkey Point's Units 6 and 7. Thank you.

CHAIRMAN HAWKENS: Thank you, Ms. Reiser. We'll now hear from Village of Pinecrest, Mr. Arango.

MR. ARANGO: Good morning, Judge Hawkens, Judge Kennedy, and Judge Burnett. My name is Jose Arango. I'm from the law firm of Weiss, Serota, Helfman, Cole & Bierman. I'm appearing on behalf of the Village of Pinecrest as its Village Chairman.

Thank you for the opportunity to provide this brief opening statement on behalf of Pinecrest.

You must determine today that the NRC Staff was reasonable in concluding that environmental impacts from FPL's proposed deep injection wells will be small when the potential exists that the chemicals, ethylbenzene, heptachlor, tetrachloroethylene, and toluene, will be injected into the wastewater into the Floridan aquifer system's Boulder Zone and could migrate into the underground supplies of drinking water.

The CDC has determined that most of these chemicals are possibly carcinogenic. For one of them it is probable.

Given the vast quantities of wastewater that would be pumped into the ground, these chemicals may accumulate over time, posing risk to human health and the environment.

This is greatly concerning to the Village, to the residents of the Village of Pinecrest, the nearest of whom live within 15 miles of Turkey Point. They are not alone.

The Keys Gate Charter School, Kingdom Covenant Baptist Church, Christ Fellowship Church of Homestead, Neighbors in Homestead, Isles of Oasis subdivision, visitors at the Southern Comfort RV Resort, the Homestead-Miami Speedway, and the Homestead Air Force Base, among many others, are well within ten miles of Turkey Point site. Some of these locations are a little more than five miles away.

It may be of little comfort to residents of and visitors to South Florida's communities that scientists involved in this proceedings disagree whether the chemicals pumped into the wastewater, into the deep well might migrate only 5 miles or as much as 13 miles from the site of injection.

They know that growth in South Florida

constantly taxes drinking water supplies from the Visgat aquifer and that the future brings ever increasing pressure to dig new wells and to find alternative sources of water including the Upper Floridan Aquifer.

The experts differ on a number of matters to be discussed today. They seem to agree on this, that seismic reflection analysis can identify water migration pathways from Boulder Zone upward when given context by other methods of testing.

FP&L has not done this type of analysis, citing its costs. Staff has not requested it, pointing out that seismic reflection data only show possible flow pathways of transport water from lower strata to higher strata in the aquifer system, but do not inform as to how well water might flow through those pathways.

If such pathways exist so that contaminated water can flow rapidly from the Boulder Zone into the Upper Floridan Aquifer, South Floridians would want to learn about their hydraulic flow properties now from FP&L's testing before the deep injection well is operating. They don't want to learn about it generations from now following an investigation into the potential causes of the cancer cluster.

Pre-file testimony demonstrates that seismic reflection analysis can be done and that it can identify false and karst collapsed structures linking different strata within the aquifer system. Pre-file testimony also outlines the limitations of seismic reflection as a complete method of analysis.

Nothing in rebuttal testimony, however, suggests that seismic reflection analysis used in concert with other study methods to provide context, will fail to provide a more thorough understanding of the confining layer's ability to protect underground sources of drinking water from toxic uploading.

Asked that the most thorough understanding of the potential for toxic chemicals to enter drinking water sources, those whose health may be at risk will find no comfort in finding that potential impacts to the environment and to the public health will be small.

Testimony sponsored by the Joint Intervenors shows that, at best, the Environmental Impact Statement is incomplete. Thank you.

CHAIRMAN HAWKENS: Thank you, Mr. Arango. City of Miami, would you care to make an opening statement? Good morning.

MR. ALBAN: Good morning, Your Honors. Xavier Alban, Assistant City Attorney with the City of Miami.

The City of Miami has serious concerns with respect to FPL's application for a combined operating license for the Turkey Point Proposed Units 6 and 7.

With respect to the contention before you, this matter specifically relates to the sanctity and protection of a designated underground source of drinking water, the Upper Floridan Aquifer.

The City is deeply concerned with the potential contamination of this underground source of drinking water. The availability of potable water for the City's residents is of paramount importance to the City. And the City's goal to ensure this availability is seriously threatened by FPL's plan to deep inject the wastewater into the Boulder Zone and the potential in contaminating the Upper Floridan Aquifer.

Potable water is a limited resource. And sea level rising is exacerbating saltwater intrusion into underground sources of drinking water.

As such, it is critical that the NRC take a "hard look" at FPL's plan to deep inject wastewater with probably carcinogens into the Boulder Zone where it has a real potential of migrating upward.

Moreover, it's imperative that FPL and the NRC Staff demonstrate to the board's satisfaction that FPL has complied with the requirements of the National Environmental Policy Act or NEPA.

Under NEPA, FPL and the NRC Staff must demonstrate that the direct effect, the indirect effects, and the cumulative impacts of proposed actions will not have an adverse impact on the natural and physical environment.

The Final Environmental Impact Statement is deficient in this regard. And FPL has failed to adequately demonstrate that the direct effects, indirect effect, and the cumulative impacts to the natural and physical environment are "small".

The environmental impacts will not be small. The estimated concentrations of ethylbenzene, heptachlor, tetrachloroethylene, and toluene in the injected wastewater in Table 3-5 do not account for various factors that would increase or that could potentially increase the concentration of these chemicals.

Additionally, the potential and probable carcinogens being introduced into an underground source of drinking water can never be considered small.

Given the impact the proposed action has on the environment and active underground source of drinking water, the City wishes for the board to consider and take a hard look at the following four specific issues and require that the NRC Staff and FPL definitively demonstrate that the impacts of the proposed deep injection wells are truly small.

First, as has been noted, the Upper Floridan Aquifer is an underground source of drinking water. Just because the water is brackish and needs to be treated prior to consumption does not lessen the direct effect, indirect effect, and cumulative impact these chemicals can have if they contaminate the Upper Floridan Aquifer.

The treatment of brackish water is also different than the treatment of radioactive carcinogenic matter in water. The assumption cannot be made that the same treatment used to make brackish water potable is similar to treatments to eliminate radioactive effluent or carcinogenic chemicals.

Additionally, the Upper Floridan Aquifer is an active underground source of drinking water that's currently being used to provide potable water to Florida residents.

With the amount of potable water decreasing every day, it is of paramount importance that the NRC Staff and FPL definitively demonstrate that the impact of these chemicals and radioactive effluent do not contaminate this active underground source of drinking water.

Secondly, the concentrations of the chemicals, some of which are potentially carcinogenic, are not accurate. The reason they are inaccurate is because FPL intends to operate as many as 13 wells within a radius of less than one mile.

With so many wells operating at the same time in a confined area, the concentration of these chemicals would be much higher than identified in Table 3-5 and would not comply with the EPA drinking water standards.

FPL and the NRC Staff have failed to consider the concentrations of these potentially carcinogenic chemicals with more than one well operating simultaneously or with the operation of up to 13 deep injection wells within the radius of less than one mile.

Thirdly, it is estimated that the injected wastewater will not travel more than five miles horizontally. However, that estimate is also inaccurate because it does not account for the horizontal migration of the injected wastewater when up to 13 deep injection wells are operating simultaneously.

That many deep injection wells at such close proximity to each other have the potential of allowing the horizontal migration of the injected wastewater beyond 5 miles and up to the high end estimate of 13 miles.

FPL and the NRC have inadequately demonstrated the horizontal migration of the injected wastewater below more than one deep injection well operating simultaneously.

Finally, an adequate geologic confining layer does not exist. USGS has identified the presence with tectonic faults and karst collapsed structures in Southeast Florida. These faults and karst collapsed structures provide a vertical pathway for the injected wastewater to travel.

Even if there are no faults or karst collapses in the area of the deep injection wells, a horizontal migration of the injected wastewater will allow the wastewater to travel further out and find these faults or karst collapses and allow the wastewater to migrate vertically into an underground source of drinking water.

Additionally, the limestone and dolomite that overlays the Boulder Zone also simply retards the upward migration of the injected wastewater into the underground source of drinking water.

Although it's layer may slow the vertical migration of the wastewater, it still acknowledges that wastewater can migrate vertically and potentially find faults or karst collapses within the limestone and dolomite overlying the Boulder Zone providing another vertical path.

As such, a layer that only retards the upward migration, an area that has known linear tectonic faults and karst collapsed structures, and the acknowledged potential of the horizontal migration of the injected wastewater all points to the fact that there is not an adequate geologic confining layer.

The City, therefore, respectfully requests that this board take into consideration the City's concerns, as well as the issues and concerns raised by Joint Intervenors and the Village of Pinecrest, and ensure that a hard look is taken to protect the environment and specifically to protect an active source of potable water for City residents, as well as residents of Miami-Dade County and Southeast Florida.

CHAIRMAN HAWKENS: Thank you, Mr. Alban. Any questions?

I have just one observation, Mr. Alban. City of Miami is here in support of the Joint Intervenors Contention 2.1. And Contention 2.1 deals with four specific contaminants. It does not deal with radioactive contaminants in the wastewater. I just want to make sure you're aware of that because you referred to radioactive contaminants several times during your statement.

MR. ALBAN: Understood. Thank you.

CHAIRMAN HAWKENS: Thank you. We'll now hear from the NRC Staff, Ms. Wright. Good morning.

MS. WRIGHT: Good morning. My name is Megan Wright, and I'm counsel for NRC Staff. On behalf of the Staff, I want to thank the parties and the Judges for the opportunity to discuss Contention 2.1 today.

As already noted, Contention 2.1 deals with the adequacy of the Staff's analysis in the FEIS regarding potential groundwater impacts from injection of wastewater effluent into the Boulder Zone.

Intervenors are concerned that the four chemical constituents named in the contention may adversely impact the quality of the groundwater if the wastewater migrates from the Boulder Zone to the Upper Floridan Aquifer.

During the time allotted to the Staff this morning, I'd like to briefly go over the main points of our position and then comment on positions Joint Intervenors have taken in their filings throughout the proceedings.

First, the NRC Staff took a hard look that NEPA requires at the environmental impacts of deep well injection on groundwater quality. Under NEPA, the Staff is required to take a hard look at the environmental impacts of a proposed action.

This is tempered by a rule of reason. So the FEIS is not intended to be a research document. The purpose of the FEIS is to disclose impacts and inform decision makers.

In preparing the FEIS, the Staff used multiple lines of inquiry in order to evaluate the potential impacts of deep well injection on groundwater quality.

For example, the Staff reviewed multiple studies that characterized the geology of the Turkey Point site and the confining ability of the middle confining unit, examined data from exploratory wells constructed at the Turkey Point site, compared parameters at sites where upwelling had occurred to parameters at the proposed site, evaluated modeling of possible pathways for the flow of injected wastewater, considered the well testing and monitoring requirements of Florida's underground injection control program, and reviewed studies published by the EPA that assess the risk to human health of injecting wastewater in the region.

The scale of these analyses allowed the Staff to adequately analyze impacts of deep well injection at the Turkey Point site, thus meeting its obligations under NEPA.

Staff witnesses will explain the bases of the conclusion in the FEIS that the impacts will be small. The Staff's conclusion is largely based on three findings.

One, the concentrations listed in Table 3-5 of the FEIS for the four constituents at issue are below EPA's protected drinking water standards. Two, the concentrations of the constituents are likely to be even lower due to additional treatment of the wastewater prior to injection. And, three, significant upwelling of the wastewater is not likely to occur. And if it did occur, it would not impact the quality of the water in the Upper Floridan

Aquifer. And I'll discuss each of these in turn.

EPA establishes Maximum Contaminant Levels, or MCLs, for drinking water that are intended to protect public health. Levels of constituents below the MCLs are considered by the EPA to be safe for human consumption.

Initial sampling at the South District Wastewater Treatment Plant, which is where the cooling water for Turkey Point will come from, found that levels of heptachlor, toluene, and tetrachloroethylene were below EPA drinking water standards. Ethylbenzene wasn't detected at all.

In fact, the water containing these constituents at these levels could be injected into the Upper Floridan Aquifer without any adverse impact on human health. But further treatment of wastewater brings concentration levels even lower. The Florida Underground Injection Control Program requires further treatment of wastewater before injection.

Samples were taken after the required additional treatment. And the levels of the four constituents were even lower than the values indicated in Table 3-5.

Concentrations of the four constituents were below what's called the Method Detection Limit, which means that the amount of chemicals was so small that we don't even have the technology to quantify it.

Because the amounts of the chemical constituents will be so low, Staff is confident in its conclusion that the risks to public health will be minimal.

The witnesses will also explain why they are confident in the confining capability of the middle confining unit. Joint Intervenors have said that the FEIS concluded that movement of wastewater was extremely unlikely. But the FEIS concluded that the wastewater moving into Upper Floridan Aquifer was extremely unlikely.

The Staff reviewed studies and confirmed FPL's modeling in order to determine the most likely scenario for movement of injected effluent in the Boulder Zone. The Staff found that upward migration would be no more than about 300 feet.

The Staff also concluded that, while some vertical migration may occur, the effluent would need to move through 1,400 feet of low permeability rock before it reached the Upper Floridan Aquifer, and this was extremely unlikely.

Further, FPL must show that the middle confining unit confines the effluent in order to be issued an underground injection control permit by the Florida Department of Environmental Protection. So there is that added layer of regulatory safety from the State as well.

Furthermore, as the witnesses will testify to today, the injection wells will be monitored. Any migration that occurs in the vicinity of the well would be detected before reaching the Upper Floridan Aquifer, and wells can be shut down.

Monitoring wells are capable of detecting potential upward movement of fluid. And this decreases the likelihood that injected wastewater will flow beyond the monitoring zone.

To sum up, Staff is confident in its determination that the injection of wastewater into the Boulder Zone will have small impacts on groundwater.

The Staff found that the risk to human health from deep well injection is low and is lowered further with high level treatment of the wastewater.

Staff also found that it is unlikely that the wastewater would migrate out of the Boulder Zone through the middle confining unit and into the Upper Floridan Aquifer. And if it did, the risk to users of the Upper Floridan Aquifer would be minimal because the water would still meet EPA drinking water standards.

Staff witnesses are prepared to discuss these findings and their conclusions today.

I'd also like to take a few moments to mention some points the Joint Intervenors have made throughout the proceeding and to make NRC Staff's position on these points clear.

First, Joint Intervenors' witness testified that the EPA's Maximum Contaminant Level goals -- I'm just going to call these the goals -- for each of the constituents, these are more stricter than the MCLs, more strict than the MCLs, excuse me, should be met because that's the level that is most protective of human health.

The Staff witnesses will testify that the goals should not be the benchmark against which the constituent levels are measured because the MCLs do provide an adequate margin of safety.

However, Staff wants to emphasize that for two of the constituents, ethylbenzene and toluene, the concentrations found in the wastewater do meet the goals.

For the other two constituents, heptachlor and tetrachloroethylene, EPA set the goal at zero.

The MCL is above zero. So the EPA determined that certain levels of these two constituents are still considered to be safe.

But it's not reasonable to expect the wastewater to measure at zero level concentrations, as the Joint Intervenors request, when the current detection technology can't even make that finding.

Secondly, Joint Intervenors argue that any concentration above zero of the constituents, except for toluene, is harmful to human health. However, even Joint Intervenors' Exhibit INT-016, which was filed to support this argument, acknowledges that small levels of these constituents in water are not harmful to human health. And this is consistent with the EPA determination.

Third, Joint Intervenors claim that Staff's information about the geologic characteristics of the Turkey Point site is inadequate and that more tests are needed. Staff does not agree with this argument.

FPL conducted all the tests that Mr. Quarles himself said needed to be conducted in his second affidavit, which is INT-003. And actually, FPL conducted even more tests than Mr. Quarles said were necessary.

And in order to comply with the Underground Injection Control permit requirements, FPL will have to conduct additional testing and monitoring at all 12 injection sites and 6 monitoring wells on the site.

Joint Intervenors also challenge the methods of gathering the data and say that seismic reflection tests are necessary for site characterization.

Staff witnesses will testify that the methods were adequate and reasonable and that the testing conducted clearly support a finding that the middle confining unit is an adequate confining unit and that vertical migration of the injected wastewater is possible but not likely.

And seismic reflection tests would not provide Staff with any information regarding the hydrologic connectivity of the geologic structures beneath the site. So this type of testing would not add any valuable information.

To conclude, NRC Staff pre-filed testimonies, exhibits, and the witness testimony you'll hear today demonstrate that the NRC took the hard look NEPA requires. The conclusions the Staff reached in the FEIS were well-supported, and

Contention 2.1 does not have merit. NRC respectfully requests that the board find as such. Thank you.

CHAIRMAN HAWKENS: Thank you, Ms. Wright. Mr. Lepre.

MR. LEPRE: Thank you, Judge Hawkens, excuse me, Dr. Burnett, Dr. Kennedy. I'm Mike Lepre, counsel for the Applicant, Florida Power & Light Company.

Thank you very much for the opportunity to appear before you today. And we also thank the City of Homestead for providing us with this terrific facility.

Underneath, the FEIS must take a hard look at the reasonably foreseeable environmental impacts at issue. The NRC is not required to look at every potential environmental impact. And it does not have to consider worst case scenarios.

As the Staff pointed out, an FEIS is not a research project. The NRC doesn't have to use every possible resource to study the potential impact as long as it uses reasonable methodologies, which it did here. The case law that we cited in our briefs makes all of this very clear.

Obviously, the Applicant believes that the NRC has more than satisfied its obligations under

NEPA. As the NRC details in its filings, it carefully examined the relevant data, conducted the necessary studies, and reached independent, scientifically supported, and valid conclusions. And the Applicant's expert witnesses agree.

These highly qualified individuals include Dr. Robert Maliva. He's a Florida-licensed geologist and foremost expert on hydrogeology in Florida.

Mr. David McNabb, he's also a Florida-licensed geologist. He's worked on both sides of these types of issues, first with the Florida Department of Environmental Protection, and then as a consultant permitting approximately 40 underground injection wells in the state.

And Dr. Christopher Teaf, a Ph.D. in toxicology, he's the current director of the Center for Biomedical and Toxicological Research at Florida State University.

From their perspective, there is simply no scientific basis for concluding that the environmental impacts at issue are greater than small or that further study is necessary.

For the board to find otherwise, it would have to discount the testimony of those witnesses and instead agree that multiple barriers to minimize the environmental impacts will all fail.

And then the board would have to find that even if all those barriers fail, the EPA's drinking water standards are insufficient to protect the public health. There's no credible basis for so determining.

I mentioned barriers. What are they? First and foremost, confinement. The wastewater will be injected 3,000 feet underground into the Boulder Zone beneath a confining layer of rock that's approximately 1,465 feet thick. That's about five football fields deep of confining rock.

Groundwater modeling shows that, at most, after 100 years the wastewater would migrate to a depth that's still 1,000 feet below the base of the lowest underground source of drinking water.

The Joint Intervenors present no modeling of their own. Instead, they simply mischaracterize and misinterpret articles to claim there might be unidentified features that could lead to vertical migration. That's not science. That's just pure speculation.

Intervenors argue that confinement could be bypassed if a well leaks. But the uncontroverted testimony in this case shows that ever since new well construction techniques were implemented 25 years ago, no Class I injection well has ever leaked. So a leak is not reasonably foreseeable.

What's another barrier? Monitoring. As Mr. McNabb testifies, FPL will implement a monitoring program for leaks and migration in compliance with the Florida Department of Environmental Protection requirements. This will include continuous monitoring of the angular space between the injection tubing and one of the outer casings. So any leaks would be detected immediately.

It will also include continuous monitoring of water levels from two zones. Joint Intervenors did not address either of these monitoring programs in their testimony.

In the extremely unlikely event that confinement and monitoring somehow fail, what other barriers are there? Well, there's dilution and volatilization.

When it's cycled through the cooling water system and injected into the Boulder Zone, the concentrations of the constituents in the wastewater will be substantially reduced to levels even further below drinking water standards. The Intervenors completely ignore the impact of dilution and volatilization.

Next, any remnants of the constituents that somehow overcome all this still won't be near any potable water source. The closest potable water source is 11 miles west of Turkey Point in the opposite direction of groundwater flow in the Upper Floridan Aquifer.

Joint Intervenors have advanced no scientific basis for the proposition that wastewater from Turkey Point would somehow travel to that site. Instead, they merely speculate that someday someone might build a potable water well at Turkey Point.

But, as Dr. Maliva testifies, that's extremely unlikely. FPL owns the land at and surrounding the site. There are no current or projected plans to build potable wells there.

And finally, even if someone eventually built a potable well at Turkey Point, there is yet another barrier. Any water accessed by such a well would be brackish. And for that reason, it would have to be treated through desalination or dilution.

Those processes would even further reduce or remove the constituents at issue if the wastewater were to somehow pass through the 1,465 feet of confining rock and avoid monitoring.

So we have confinement, the well

construction, monitoring, multiple stages of dilution, flow direction, no nearby potable wells, volatilization, and desalination.

But let's assume for a moment all of these are ineffective. What are the consequences? Well, the concentrations at issue here, which the parties have agreed are conservative, are already well below federal drinking water standards.

Put simply, the EPA allows the constituents in the concentrations set forth in the FEIS to be present in its drinking water systems because there are no adverse human health impacts. That fact alone supports a finding that the impacts at issue here will be no greater than small.

But Dr. Teaf puts an even finer point on it. His expert testimony shows that you need to have much greater concentrations than those at issue here to even begin to see any measurable adverse impacts.

Depending on the constituent, studies shows that the concentrations at issue would need to be multiplied by thousands or tens of thousands for even measurable impacts.

As Dr. Teaf testifies, the mere presence of a chemical is not enough to say there will be an adverse health impact. You obviously have to take into account dose, concentration, and drinking water intake levels.

There's no basis for the NRC to apply to this wastewater, which will be confined 3,000 feet below the surface, a standard that's greater than the EPA applies to systems that actually distribute drinking water to the public.

Finally, Intervenors want more data. But as Dr. McNabb, as Mr. McNabb, Dr. Maliva, and the NRC experts all testify, more data is simply not necessary.

As the uncontroverted testimony shows, the data requested by Joint Intervenors, including more than one exploratory well and seismic reflection surveys, have never been required in the history of permitting Class I injection well systems in Florida.

Intervenors imply that seismic reflection surveys are some kind of new technology. That's simply not true. Dr. Maliva testifies that seismic reflection surveys have been performed for other purposes in Florida since the 1970s.

The reason they have not been used for injection well permitting is because they're not useful for that purpose. And they're not necessary.

In the entire history of the deep well

injection program in Florida dating back to 1943, through over 180 injection wells, wastewater has never entered the potable supply well. It's just not reasonably foreseeable that that will happen here.

For all these reasons, the FEIS accurately characterizes as small the reasonably foreseeable environmental impacts at issue in this case. Thank you.

CHAIRMAN HAWKENS: Thank you. At this point, as the board mentioned earlier, we're going to take a short recess so the first panel of witnesses can sit. Ms. Curran, would ten minutes be adequate to sit your panel of witness?

MS. CURRAN: Yes, thank you.

CHAIRMAN HAWKENS: And that would be adequate for FPL and the NRC Staff as well?

MR. LEPRE: Yes, it would.

MS. WRIGHT: Absolutely, yes.

CHAIRMAN HAWKENS: Thank you. We'll take a ten-minute recess and reconvene at about 37 after. Thank you.

(Whereupon, the above entitled matter went off the record at 10:26 a.m. and resumed at 10:38 a.m.)

CHAIRMAN HAWKENS: Ms. Curran, earlier you asked the question about the possibility of leaving belongings here in the hearing room. We checked with the Office of the City Clerk. She said you may, that they would lock the doors. However, individuals themselves would be responsible for what they left behind. The City of Homestead cannot assume responsibility for the security, but you may do it, and they will lock the doors.

MS. CURRAN: Great. Thank you very much.

CHAIRMAN HAWKENS: All right. We've seated the first technical topical panel for the evidentiary hearing. As a reminder, the topic for this first panel is the ability of the hydrogeological layer unit above the boulder zone to prevent wastewater from migrating upward to the Upper Floridan Aquifer, the likely extent of horizontal and vertical migration of wastewater after it's injected into the boulder zone, and the predicted velocity of such migration.

Would the witnesses for each party please introduce themselves for this panel, starting with Joint Intervenors.

MR. QUARLES: My name is Mark Quarles.

DR. MALIVA: Robert Maliva.

MR. McNABB: My name is David McNabb.

MR. THORNE: My name is Paul Thorne.

MR. BARNHURST: My name is Dan Barnhurst.

CHAIRMAN HAWKENS: Thank you. Good morning.

DR. BURNETT: Good morning. I'd like to first ask for a display to be shown. It's Florida Power & Light-003-015. It shows the hazard geologic section at Turkey Point. Thank you.

Dr. Maliva, so this was in your pre-filed testimony and I wanted to just be clear. Are you comfortable with this hydrogeologic representation?

DR. MALIVA: Yes, I am.

DR. BURNETT: I notice that the Avon Park Permeable Zone, abbreviated APPZ, has a question mark next to it. Could you explain why that's the case?

DR. MALIVA: Well, the Avon Park Permeable Zone is an interval of fractured dolomite which is present there in most of Southeastern Florida, at both the Turkey Point site and South District. It's just not as well developed so those were approximate depths. You do find more permeable zone there but it's not as well developed as elsewhere.

DR. BURNETT: Not as well developed. Would that mean it's thinner than it is elsewhere?

DR. MALIVA: Well, you've got, I guess,

the same intensity of fracturing as detectable on geophysical logs. So there's a more permeable zone present there, but it's not as permeable as elsewhere.

DR. BURNETT: Okay. Is the Avon Park Permeable Zone part of the Upper Floridan Aquifer?

DR. MALIVA: No, not as currently defined. It's the zone within the middle Floridan confining zone. It separates that into an upper and lower zone, so it's by definition within the middle confining.

DR. BURNETT: So in past classifications perhaps it was included as part of the Upper Floridan Aquifer?

DR. MALIVA: There was some interpretations that put it there, but the current interpretation which was based on most recent U.S. Geological Survey regional investigation of the Floridan Aquifer system by I guess Reese & Richardson now clearly place it within the middle of the middle confining zone. So it's not part of the Upper Floridan Aquifer.

DR. BURNETT: Is the Avon Park Permeable Zone, would you consider it an underground source of drinking water?

DR. MALIVA: It depends on the depth at which it's located with respect to the 10,000 milligram per liter TDS line. So it could be above or below it. Here, it's below the base of the USDW.

DR. BURNETT: So the underground source of drinking water is defined not only by the total dissolved solids being less than 10,000 milligrams per liter, but also by the depth below surface?

DR. MALIVA: No, the base of the USDW is defined purely as based on the 10,000 milligrams per liter of TDS. It's purely a water quality --

DR. BURNETT: So it's purely water quality for the definition?

DR. MALIVA: Yes.

DR. BURNETT: So even though the Avon Park Permeable Zone is not well developed at Turkey Point, does the water quality meet that less than 10,000 milligrams per liter limit?

DR. MALIVA: The base of the USDW is at 1,450, so it's high, greater than 10,000. It's not part of the USDW at Turkey Point.

DR. BURNETT: Okay. All right, so it wouldn't be considered an underground source of drinking water then?

DR. MALIVA: No, it would not.

DR. BURNETT: Okay. You don't happen to know what the total dissolved solid concentration is, do you offhand?

DR. MALIVA: I don't know the exact --

DR. BURNETT: But you believe it's greater than 10,000?

DR. MALIVA: Well, it's definitely below 10,000. That's part of -- for any injection project, a key requirement is to locate the lowest depth at which water greater than -- with less than 10,000 occurs. That's the -- called the base of the USDW. Everything below the base of the USDW is greater than 10,000. So where it is in that spectrum from 10,000 to 35,000 sea water salinity I'm not sure --

DR. BURNETT: Some time during the course would you be able to identify where in the record that information is? If the APPZ is less than 10,000?

DR. MALIVA: No, the APPZ is greater than 10,000.

DR. BURNETT: Right. Would you be able to cite something in the record for the Licensing Board? It need not be now but sometime during --

DR. MALIVA: Oh, yes, we can do that for you.

DR. BURNETT: Thank you.

DR. MALIVA: Mr. McNabb has that information.

DR. BURNETT: We'll come back to that once someone locates it.

There seems to be some slight disagreement about where the primary confinement layer begins. In the diagram it shows it beginning at 1,930 feet if I'm interpreting this correctly. Is that correct?

DR. MALIVA: Well, the confinement between the injections on the base of the USDW is provided by the cumulative thickness of strata between those depths. So each interval can provide incrementally some confinement. But the most effective lowest permeable strata does occur at the bottom of that interval. So 1,900 feet is between the top -- the bottom thousand feet provides the most effective confinement. That's the tightest strata there.

DR. BURNETT: In the report, I believe authored by Mr. McNabb, the primary confinement layer was stated to begin at 1,980, so slightly different.

DR. MALIVA: It's approximately. It's not a --

DR. BURNETT: Yes?

MR. McNABB: I believe the report indicated 1,930.

DR. BURNETT: Okay, perhaps my notes are in error. Thank you.

Could I ask Mr. Quarles to comment on this hydrogeologic section? Are you comfortable the way the positions are made?

MR. QUARLES: So, first of all, good morning. Thank you for allowing us to be here, Your Honor, Dr. Kennedy and Dr. Burnett.

You know the conceptual cross section up there was presented. When you look at the data that was produced from the single bore hole EW1 which went down to about 3,000 feet, what is clear is that they make reference to primary confinement which is from 1,900 down to about 2,900 feet.

What I didn't see in the McNabb report on the EW1 was that there was no clear definition of what all the other published studies talked about. There was a sandwiched APPZ, the Avon Park Permeable Zone and then the traditional confined layer, MC1 above and MC2 below that you see here and in other USGS type documents.

So according to the EW1, there's some question about whether or not the MC1 exists and whether or not the Avon Park Permeable Zone. I guess in the big picture, the bottom line is that when you look at the EW1 report, they're measuring water quality at different intervals and there are intervals that are reported to be less than 10,000 milligrams per liter TDS which is indicative of a regulated USDW.

So what is unclear is whether or not there is an APPZ and most reportably beyond that is whether or not there's an upper MC1 above that USDW before you get to the intermittent confining layer of the Biscayne Aquifer.

DR. BURNETT: So what you're calling the MC1 is that what is referred to in the diagram as the Middle Floridan Confining Unit at 1,430, 1,450?

MR. QUARLES: So I didn't produce that diagram, but when you look at traditional USGS type documents and such, there are no confined layer. MC1 is traditionally located above the Avon Park Permeable Zone and the MC2 being below the APPZ in the Lower Floridan Aquifer.

DR. BURNETT: So I'm going to ask for another section. So Andy, could you pull Joint Intervenors Exhibit 12, page 4. Yes. Thank you.

So is this closer to what you were referring to? This is, by the way, this is from a publication by Walsh & Price, 2010.

MR. QUARLES: That is what you traditionally when discussing the confining layers in the Avon Park Permeable Zone.

DR. BURNETT: Do you happen to know -- so this is for the site. It's not the same site. It's for the North District and the South District Wastewater Treatment Plants in Dade County. So it's actually a composite of two sites. And notice that the Avon Park Permeable Zone doesn't have a question mark here. Do you happen to know if the water in that zone would be considered an underground source of drinking water?

MR. QUARLES: Any water that has a TDS less than 10,000 milligrams per liter is a USDW regardless of whether it's an Avon Park Permeable Zone or whatever formation it comes from.

DR. BURNETT: Okay.

MR. QUARLES: So whether or not the Avon Park Permeable Zone exists or this thick at Turkey Point is important, but it's also -- we have to recognize that any ground water that meets the definition of USDW is protected ground water.

DR. BURNETT: Thank you. Mr. Quarles, you had mentioned in your pre-filed testimony that the core sampling program only included 122 feet of the entire 33,230 feet well which translates to about 4 percent of the total. So the core recovery is low for the test well.

On the other hand, didn't the geophysical logs monitor the entire sequence?

MR. QUARLES: The geophysical logs typically do monitor the entire sequence. So what happens is you use data that you collect from perhaps a pilot hole and then that helps you select your intervals that you're going to test for your analytical testing across the permeability hydraulic conductivity, that sort of thing. So it does help you kind of pre-select what you suspect to be the confining layers because you have to use that information, the actual analytical and numeric data to support your determination of confinement.

DR. BURNETT: So from the geophysical logs themselves, can you define the confining layer?

MR. QUARLES: I typically rely on the analytical data itself because it's an actual sample that is pulled from the ground that you can see. It has a numeric value that's useful for any sort of calculations that you might run.

DR. KENNEDY: Can I jump in here? Are you suggesting that you discount the geophysical log data over the -- I guess the analytical, you meant the raw data from the borings?

MR. QUARLES: I'm not saying you discount that. It's just part of what you use to determine where you think you need to collect your samples for determination of confinement.

DR. KENNEDY: Would you suggest in that some vein that -- I know in your testimony you had some concerns about the number of core samples that were taken and that the full length wasn't represented.

MR. QUARLES: Yes, so let's put this into perspective. Three thousand foot hole, you decide to core 122 feet. And you do that based on your observations of the hydro cuttings and the geophysical because you have to make a numeric determination for the confinement.

Some of the other experts have said that seismic doesn't give you a numeric value on whether or not how much or how quickly ground water might migrate to a conduit, for example. Geophysical evaluation doesn't give you a numeric value of why transmissivity in the hydraulic conductivity. That's why you collect these samples and do Packer tests that that sort of thing. So it's just part of the investigation.

So when you go and you collect a core sample, you have to recognize that this is perhaps a two inch diameter core that you're pulling out of the ground. And so then this is where the percent recovery and the percent porosity come into play because you manually grab and select two- to four-inch interval of that core sample to submit to your laboratory for analysis. So you cannot manually select a sample for an analytical test for porosity conductivity if it's intact or most importantly if it didn't recover it at all, if it didn't recover in your core sample it could be because it's extremely fractured. If it's extremely fractured and you had high porosity or low recovery, that sample, analytical value that you sent to the lab would not reflect the worst case scenario because it's what you're able to retrieve, not what didn't come up out of the ground.

DR. KENNEDY: I think I understand that specific example. Did you review NRC Exhibit 056 which is the data from the exploratory well 1? It appears to be an extensive array of data.

MR. QUARLES: I did. So what's really fascinating on this is that you have a number of values of hydraulic conductivity and generally they were in the 10^{-4}, 10^{-6} centimeters per second permeability or hydraulic conductivity range. Right?

So if you -- so then you say okay, what does that mean? Well, Mr. McNabb concluded that those values indicated the confined nature of that thousand-foot section, appeared, I think the word was appeared to indicate confinement. But when you look at, like for example, the STAR Report, the Idaho National Lab that was done, the investigation for the South District Wastewaster Treatment Plant, when they reviewed existing data for the South District Plant they said that the data were not sufficient to demonstrate confinement. And in particular, he pointed out that permeability or hydraulic conductivity values in the range of 10^{-4} which I believe 38 percent of the core samples that were sent at Turkey Point represent 10^{-4} were representative of a vertical permeability or seepage rate equivalent to a silty sand. So that would not be indicative of confinement.

DR. KENNEDY: Let me interrupt you. That was for the South District Water Treatment Plant?

MR. QUARLES: Correct.

DR. KENNEDY: Which is some distance from the Turkey Point site?

MR. QUARLES: It's about nine miles.

DR. KENNEDY: Now this data here that's in NRC Exhibit 056 this is data for the Turkey Point site.

MR. QUARLES: It is. But what I did was a comparison of -- like 38 percent of the values of hydraulic conductivity were 10^{-4}. They did range from 10^{-4} to 10^{-6}, but a lot of them, 30 percent, were in the 10^{-4} range which according to publications, that's indicative of a flow rate of a silty sand which is arguably not very confined.

DR. KENNEDY: Does 10^{-6} indicate more confinement or less?

MR. QUARLES: It does, yes.

DR. KENNEDY: Let's go back to the 38 percent. It was 10^{-4}, is that what you said?

MR. QUARLES: Yes.

DR. KENNEDY: Does that mean there was 62 percent if it was 10^{-6}?

MR. QUARLES: That does.

DR. KENNEDY: And what I understood you to say is that FP&L selected a value that's at the end of that confinement region, the 10^{-4} value.

MR. QUARLES: The conclusion was that the hydraulic conductivity values between 10^{-4} and 10^{-6} were all indicative of confinement.

DR. KENNEDY: Okay, thanks for clarifying that.

DR. BURNETT: Sir, I'd like to go back to

Dr. Maliva and could I ask for Exhibit FPL-003-60. So I want to go back to the question concerning logging and how we interpret them and what do they tell us? I believe this is from one of your publications.

DR. MALIVA: Not this particular figure, but I've seen this before.

DR. BURNETT: It was entered as an exhibit from Florida Power & Light. And the diagram on the left is actually from Turkey Point. It's from EW1 and it's showing sonic velocity.

DR. MALIVA: Yes.

DR. BURNETT: The one on the right is from Houston and I believe that's near Lake Okeechobee, so it's in the north. And it's also showing sonic velocity. And you can tell the profiles are quite different. Could you explain how you can tell whether or not layers are confining or not confining based on this comparison?

DR. MALIVA: Yes, this actually is a critical issue. Based on the modeling that I did both before I was involved with Turkey Point as part of this project as well as the EPA modeling, the middle confining zone strata, if it's not fractured, if it's a sufficiently low permeability, that it would act as an effective confining zone. The cumulative thickness again is sufficient to keep migration to USDW.

Where confinement has been compromised is where there's been widespread fracturing of the confining zone. And the bore hole geophysical logs is absolutely critical for confining analysis because it provides a continuous record of the bore hole and you can readily recognize unfractured from fractured strata.

One indication of fractured is you have very long sonic transit times. Another evidence is just on a caliper log you can see the bore hole diameter spikes and the bore hole diameter. So for any injectional project in South Florida, the critical task is just to look at the state of the confining zone strata. Is it fractured? Is it unfractured? And this was provided as an example of the two extremes.

We have the Turkey Point log here and we see similar things at other wells in South Florida. The Florida Keys Aqueduct Authority is similar to the FPL well where we don't have very minimal fracturing. But then there's other wells where fracturing is much more widespread. So whenever we look at a new injectional project, we want to see what we see at Turkey Point that we don't see very low sonic transit time is usually ideally less than 80 micro seconds per foot for most of the interval. We don't want to see any sort of bore hole enlargement associated with fracturing. So again, this is sort of a diagram showing what you don't want to see versus what you do want to see if you have effective confinement and the bore holes geophysical logs from Turkey Point are very clearly in the good confinement category.

DR. BURNETT: If you look at the Turkey Point log, can you recognize layers that aren't permeable?

DR. MALIVA: Well, you can identify layers that have higher porosity. The sonic porosity is related. Porosity can be estimated from the sonic transit time to get -- the sonic log doesn't give you permeability directly. Now what we do to get estimates of hydraulic conductivity is we use the core data to get a transform of hydraulic conductivity versus porosity and then we apply that equation to the sonic log to get a hydraulic conductivity versus depth of profile. But there's no way from a bore hole geophysical log to directly measure permeability. You have to get at it using other parameters.

DR. BURNETT: Let's take a look at another one. Could we go to Florida Power & Light 61, Exhibit

61, page 18? And I want to focus on the geophysical logs on the right-hand side.

So this is showing the --- what's called the caliper which apparently gives you the size to the bore hole.

DR. MALIVA: Yes, here we have the bore hole diameter, yes.

DR. BURNETT: This is not from Turkey Point, but it does show -- now there's two lines. There's a red line and a blue line. One is an X and one is a Y caliper, is that just dimensions?

DR. MALIVA: Yes, the way the tool operates, the caliper log has sort of two arms connected by a -- on the sort of spring tension and 90 degrees, they're orthogonal to each other, so you get two readings of caliper. And this is the way of looking at asymmetry of bore hole, of the bore hole diameter. It's giving you a minimal and maximum direction.

DR. BURNETT: So the X and Y are equal, it seems to be in most cases.

DR. MALIVA: The circular bore hole.

DR. BURNETT: Then it's symmetrical. Okay. So going down, it looks pretty even and then around 2,450 or so it suddenly changes. So what does that -- that simply means a hole that larger for some reason?

DR. MALIVA: Yes, above 2,400, you're getting into the injection zone there which occurs about 450 feet shallower at South District than here. So again below 2,400, you're into the boulder zone there. So you see greater bore hole diameter and greater sonic transit times. So again it really contrasts the bore hole response to unfractured strata versus the fractured strata of the boulder zone.

DR. BURNETT: Let's go to another area. Could you show the Joint Intervenors Exhibit 14, page 8. I'm going to direct questions again to Dr. Maliva because this, I'm sure, is from one of your papers.

DR. MALIVA: Definitely.

DR. BURNETT: It's got your name on it.

DR. MALIVA: Definitely.

DR. BURNETT: And this concerns some modeling that you did?

DR. MALIVA: Yes.

DR. BURNETT: And tell us of your modeling. So looking at the diagram, the warm colors represent high dissolved solids. So 35 would be equivalent to sea water. And cool colors represent fresher water and then you have everything in between.

And you can see the diagram on the bottom shows the structure of what you're looking at. So I'd like to ask you about Scenario B. And if I understand this correctly, each scenario is based on different assumptions that you put into your model.

DR. MALIVA: Yes.

DR. BURNETT: So in Scenario B, the second one from the top, the cooler colors which could indicate waste water because that tends to be fresher is migrating vertically and horizontally, but it's migrating vertically to the extent that it does seem to intercept the Upper Floridan Aquifer.

So I guess my question is Scenario B were the assumptions you made realistic? And could you remind me what the time frame is to go from the starting conditions to the ending conditions?

DR. MALIVA: I don't recall the specific time conditions. Basically, what the modeling -- we modeled the Baseline Scenario A which is based on actual field ideologic conditions using the type of hydraulic conductivity, vertical hydraulic conductivities.

DR. BURNETT: In Scenario A, the conductivity was 10^{-7}.

DR. MALIVA: Yes.

DR. BURNETT: In Scenario B, you changed the hydraulic conductivity to 10^{-3}. So it's four orders of magnitude different.

DR. MALIVA: Yes, and if the hydraulic conductivity was much greater, yes, you're going to have very rapid vertical migration and the rate is going to depend upon what value you assign to the vertical hydraulic conductivity.

DR. BURNETT: Now this was not done for the Turkey Point site, but was done for South Florida type geology?

DR. MALIVA: Yes, this was purely a theoretical paper that we did. It was roughly based on some of the data from Palm Beach County, but it was purely an academic exercise.

I've written several papers. Once this upward migration issue occurred, we looked at detail to try to understand why upward migration occurs, what are the hydrogeologic conditions that would allow water to move up to a USDW.

So we developed a hypothetical model for the Floridan Aquifer System and did various simulations to change different variables. It was sort of if we have this condition, then we get very rapid migration. But if our hydraulic conductivities were the values that we mentioned in the formations, we wouldn't see vertical migration.

And we did a similar model based on Turkey Point that was --

DR. BURNETT: Mr. Quarles had stated a few minutes ago that the hydraulic conductivities in the bore hole from Turkey Point was in the range of 10^{-4} to 10^{-6}. So if you had put those kind of values into this model, how much would Scenario B have changed?

DR. MALIVA: Well, the way I would answer that is we did a site-specific model for Turkey Point similar to this. It was actually a modification of this model using the actual data from Turkey Point. And our model results showed that after 60 years of injection and another 40-year period of no injection, that is after a 100 year time frame, the top of the injected water would have risen about 400 to 450 feet and the top of the injected water would still be about 1,000 feet below the base of the USDW. So that model which was also provided is based on site-specific data for Turkey Point this was again a theoretical model for what was basically an academic study.

DR. BURNETT: In the Turkey Point model that you referred to, do you recall did you use the conductivities that we just mentioned, 10^{-4} to 10^{-6}?

DR. MALIVA: It incorporated a whole range of values. The model was based on hydraulic conductivities that were obtained to ones actually measured. I used the sonic log to get a crossing versus at profile and then I used a transform of hydraulic conductivity versus porosity from the core data to get a vertical and hydraulic conductivity versus depth profile and that data was upscaled to the model grid. So the model was based on actual data.

DR. BURNETT: Okay. Switching gears a little bit, in your pre-filed testimony, you mentioned that ground water flow in a boulder zone suggests that flow is in a westward or inland direction at an extremely slow rate, less than 60 feet per year.

The question is can the wastewater flow faster than the regional flow because of the pressure of injecting it underground?

DR. MALIVA: Well, the rate of lateral horizontal flow of wastewater is largely a matter of just physical displacement. You inject a certain volume of water into sort of a disk. You have a certain thickness, certain porosity. The water is going to move much faster than that ten feet. That's just the ambient gradient. But again, it's purely a physical displacement. How far out the water moves in a given time interval is going to depend on the injected volume, the injections on thickness, and the porosity of the injection zone. Really, hydraulic gradients or natural flow of gradients would be much less than that.

DR. BURNETT: Thank you. I'd like to ask Mr. Barnhurst a question along the same lines. You had indicated that the natural flow in the boulder zone in Eastern Florida is generally westward and very slow on the order of thousands of years to cross peninsula Florida. Do you know offhand how did they determine the direction and the speed? You had mentioned a citation from Meyer in 1989.

MR. BARNHURST: Yes, sir. Meyer is one of the exhibits that we included, I believe, and I'm looking for the exhibit number.

DR. BURNETT: It's NRC-018.

MR. BARNHURST: 018. Thank you.

DR. BURNETT: If you go to Meyer and if you would permit me to do that quickly, Meyer used a number of ways to estimate the velocity of movement in the boulder zone. One of those ways was age dating using carbon-14. Here we go. It's Figure 12, Figure 13, I used the parent carbon-14 each dating from different sites in Florida. And so based on the differing ages of waters at those sites, he developed an idea of how long it took the water to flow between those two sites.

On page G-23 of that exhibit, he gets a range based on his data and also based on previous reports.

DR. BURNETT: Okay, that's fine. So it's based on carbon-14 data?

MR. BARNHURST: It's based on carbon-14 and he estimates --

DR. BURNETT: Presumably, the ages got older that you went --

MR. BARNHURST: Older as you moved inland. And it was about 55 feet per year, I think, 54.6 feet per year on average.

DR. BURNETT: Okay, good. Mr. Thorne, you had mentioned in your pre-filed testimony that any migration within the boulder zone beyond the site would move northeast toward, but beneath Biscayne Bay and away from areas in which the upper aquifers are used.

But I thought the flow in the boulder zone was to the west? So is it actually --

MR. THORNE: I believe that was based on the displacement of water by the injected water of the water at the boulder zone.

DR. BURNETT: It wasn't a regional flow?

MR. THORNE: Right. I believe that's correct.

MR. BARNHURST: If I could also add to that, that was a part of the -- I believe the environmental impact statement and in our testimony, we were talking about a hydrogeologic conceptual model flow accounting for injection. And so -- and it was based on previous studies, one of which is McNeill 2002 that is one of our exhibits. It talked about the surface structure on the bottom of the middle confining unit and how it dips slightly to the northeast.

And so in that discussion we were talking about the different steps of the wastewater, the injected effluent would likely take after it was injected first moving regularly outward. And as it moved away from the injection pressure being maybe more effluence since it was on top of the water column because it was less dense. By the structure on the bottom of confining unit and flowing, potentially flowing in the direction of the up-dipped portion of that confining until it mixed more and then became more a part of the natural westward movement of the water in the boulder zone.

DR. BURNETT: In your analysis, was the analysis for one well pumping all the time or more than one?

MR. BARNHURST: The evaluation in the environmental impact statement was an evaluation of one well but pumping at the total, the injection rate that would be expected from all 12 wells.

DR. BURNETT: And by the way, is it actually, 12 or 13 wells?

MR. BARNHURST: From my understanding the exploratory is an additional well, so --

DR. BURNETT: It would be 13.

MR. BARNHURST: Twelve plus the exploratory well.

DR. BURNETT: So 13. Okay. So what do you think the difference would be if you have one well that's in your analysis pumping at full capacity or if you had all 13 wells pumping at full capacity? How would that affect the flow direction and velocity?

MR. BARNHURST: I don't believe there would be an effect on the flow direction and the velocity. I think one way that may be to consider the evaluation of one well pumping is more conservative than all wells pumping is that you have the total flow rate going down one well and so it would -- there would be more going -- you would have I guess more velocity in that one location and so if you were to spread that out over the additional wells, you would be injecting the same amount in the area of the site, but you would have to inject at a lower injection rate per well.

DR. BURNETT: And so if you halve the number of wells, say five or six wells, I don't know if it's the same total flow --

MR. BARNHURST: Same total flow.

DR. BURNETT: Your opinion is it wouldn't change the velocity or direction?

MR. BARNHURST: I believe the evaluation of the EIS is conservative because we evaluated it with one, so no, I think overall it would affect that.

DR. BURNETT: Can I ask Mr. Quarles, do you have an opinion on that? Does it matter if you have one well pumping the full amount or if you have all 12 or 13 wells, pumping the same total amount, but distributed on different wells?

MR. QUARLES: So let me respond to that kind of by also adding about the velocity and the rate of flow, direction flow. A study done by Dawson, I don't remember if it was the 2007 or 2010 report that she did talked about one of the injection sites, not Turkey Point, but talked about water level rose in the Upper Floridan Aquifer by 20 feet in about 30 years.

So what that means is that the no confining layer number one was not intact to prevent that from happening. So ground water flows by pressure, so the direction is influenced by pressure or if you're pumping water from it, it would be -- I hate to call it a vacuum, but nonetheless, it's flowing by pressure.

So if you have water that rises 20 feet at the point of injection, then you would expect the direction of ground water flow to be much different than an ambient ground water flow.

So to respond to your question directly about 1 well versus 12 wells, well, my guess is the model that's in the assumption of the thousands of years and flowing is based upon the conductivity and no enormous vertical leakage. So if you have one well that's injecting and you're not around a natural conduit fracture or fault, perhaps a collapsed structure, that sort of thing, that would be much different than if you had 12 wells that perhaps might be located in the vicinity of a natural feature fracture that might lose water vertically. So I think that there would be a difference in the rate and direction of flow with 12 wells versus 1.

DR. BURNETT: Okay, so it depends on where the wells are sited relative to other features?

MR. QUARLES: That's right. And so like if I could go back a little bit, you know the ground water model that Dr. Maliva was talking about -- let's remember, too, that EPA and their UIC preamble rule in 2005 said that they didn't really have any confidence in ground water modeling being representative of the actual flow rate direction, and risk just because of the complexity of Southeast Florida.

The other side of that is let's remember, too, that we're using data from a single well point, EW1. So the geophysical logs, for example, would not represent a widespread evaluation of the entire site because the geophysical logs are in the immediate vicinity of the bore hole, so there's a lot of variables that would go into that. But the fact is if you don't incorporate those natural features and the possibility and probability of those happening, then you're just relying upon generic information.

DR. BURNETT: Thank you. Dr. Maliva, you mentioned in your pre-filed testimony that ground water modeling that you used, you used a model called

SEAWAT, S-E-A-W-A-T.

DR. MALIVA: Yes, I have.

DR. BURNETT: Which is an density dependent solu-transport code.

DR. MALIVA: Yes.

DR. BURNETT: Because it's density dependent the salt content is very important and so the question is do we have a good idea of what the salt content of the waste water is including the treatment it receives at Turkey Point and before it's injected?

DR. MALIVA: Yes. I use the value that the design engineers came up with, it was about 5,000 or so TDS. The value that I used was based upon the wastewater composition and the number of cycles that would go through the cooling cycle. Those numbers were provided to me. I did not do an independent evaluation of that. But it's fairly fresh, so it will be a high buoyancy. And that's the reason why vertical migration occurs. It's driven by the lower salinity and that's greater buoyancy as the wastewater --

DR. BURNETT: But if you recall, the number is around 5,000 milligrams per liter?

DR. MALIVA: The 4,000 to 5,000 range.

DR. BURNETT: Can anyone on this panel address that question? And to be more specific what I'm interested in is the salinity of the water that's actually injected after all the processes that is experienced and how constant that value is. If it's 5,000, is it always 5,000? Or is it plus or minus 2,000?

It seems like the result of the model will depend critically on that value.

DR. MALIVA: Well --

DR. BURNETT: The vertical flow is because of buoyancy.

DR. MALIVA: Right. Yes, the model results are sensitive to the salinity of the injected water, but up to a point. It's not so sensitive that if we modeled it at 5,000 or 6,000 or it was 4,000, we'd get grossly different results.

DR. BURNETT: It wouldn't change that much?

DR. MALIVA: It's not sensitive to that. If you change it to the situation where the alternative disposal strategy of injecting sea water, then it's totally different because you don't have the buoyancy. Again, the model results isn't sensitive to small variations in salinity.

DR. BURNETT: Mr. Quarles, so you mentioned in your rebuttal testimony that the EPA does not believe that modeling can provide an adequate demonstration of the complex geology of Florida. What did they suggest instead?

MR. QUARLES: So EPA recognized that all these injection well sites had received an investigation of collecting data the old fashioned way, traditional methods, and that a large percentage of those were not representative of the actual conditions to demonstrate confinement and protection of ground water.

So it talked about -- and this is a 2005 UIC rule or preamble change to the rule. So it talked about other technologies would be useful to be able to demonstrate these conduit-type situations that seemed to be occurring. They didn't specify one technology or the other, but clearly the use of seismic technologies would fill a void and be very useful and reasonable when it comes to explaining the instances of unintended vertical migration of wastewater.

DR. BURNETT: They didn't specifically mention seismic reflection.

MR. QUARLES: I don't recall that it did.

DR. BURNETT: If one used seismic

reflection techniques and generated these profiles and you see tectonic faults, as Mr. Cunningham has shown in his papers, does that necessarily mean that they will be hydraulically active?

MR. QUARLES: It's certainly as Mr. Cunningham had concluded it, represents a plausible pathway and could explain all the other unintended vertical migrations.

Let's also consider -- his work talked about not only the faults and the faults breaching multiple confined layers and multiple bedrock formations and they illustrate that. But let's also talk about what is not really discussed, but it's no doubt occurring, is that you can have vertical joint sets that are related to like, for example, karst collapsed features that are not necessarily faults. Right?

So if you remember that the bedrock originally was laid down as a parallel flat structure and then through tectonic forces you have some rises, you have some falls, you have some collapses. And so these fractures in these vertical joint sets that are no doubt occurring can also span different bedrock formations.

DR. BURNETT: Thank you. So could I have

Joint Intervenors Exhibit 9, page 13? Thank you. This is from one of the -- I guess it's probably the most recent paper by Cunningham, 2015 and it shows the seismic reflection profile from Biscayne Bay and the blue areas are interpreted as being more permeable. The red is less permeable. And the yellow straight lines are interpretations of some of the faults that had been mentioned.

Could I ask Dr. Maliva, can you see how migration could be potentially active on some of these faults?

DR. MALIVA: A couple background points I need to make first. This discussion of faults and collapsed structures, even going back further, subsurface deformation has been an interest of mine for well over a decade. I published a couple of papers on it in 2004, 2006, discussing again it was a Miocene/Pliocene deformation event that impacted much of Florida. I give examples, numerous examples of where I found this using well data and seismic reflection data. But a critical point is that this was a Miocene -- an event that occurred during an Miocene and Pliocene epochs several million years ago. So we have to be clear. This isn't modern faulting. This isn't karst collapse such as you see in North

Florida or Central Florida. This is a fossil event that's very widespread.

And none of this -- Dr. Cunningham collected, and his team, some outstanding data here. But his interpretation is just speculation. If you read his reports, he just made a comment these things may be plausible. I'm not sure if plausible means -- you could say that it means a non-zero probability. Well, anything is possible.

He provided no evidence that there are flow features. He didn't even provide any discussion of why he thought they were flow features. And this is a widespread phenomenon in Florida. I worked on a site in Palm Beach County, East Central Wastewater Treatment Plant where I was putting in a new injection well and there were already six wells there and the data clearly indicates that one of these features goes right through the site. It was an earlier paper that identified it as being under a fault or a fold or some sort of other deformation feature. It literally passes between injection wells 3 and 4.

But when you look at the data, there's no suggestion whatsoever about the migration at the site. Effluent was never detected in any dual zone monitor well. And when we installed the seventh well, we were very careful to see how far up did the wastewater migrate up that site. And this is a major injection on site, over 100 million gallons a day is injected. And the injected water was still 650 feet below land surface.

So again, you have one of these features that it's unequivocal. I independently reviewed the data, but it's not active. So I mean the seismic reflection is wonderful data, but it doesn't provide you actionable information. You get no information about the properties of the strata. So that's why it's never been done. And we've been using this technique since the 1970s, USGS has done seismic reflection and has shown this Miocene/Pliocene deformation event evidence for it. And there's a reason why it hasn't been done because it isn't useful.

MR. McNABB: If I could and this is a minor clarification. Dr. Maliva had indicated that injected water was detected at 650 feet below land surface, I believe.

DR. MALIVA: Below the face of the USDW.

MR. McNABB: Good correction. They are not land surface, it was below the base of the USDW.

DR. MALIVA: Okay, thank you for

correcting that. And I've seen other sites, too, and Bonita Springs is a huge deformation structure there. They have injection. It was on a plank in the middle. No upper migration. The seismic reflection is an actionable information. It's very useful from a historical geology perspective to try to identify what happened in the past, but it's not useful information. Certainly, it's not worth a million dollar plus cost to run it and process the data.

DR. BURNETT: It doesn't really matter when the fractures occurred though, does it? I mean if they're there, they're there.

DR. MALIVA: Well, fractures tend to heal over time. You get fracturing. You get circulation of water. You get cements precipitate and you very frequently see that in cores and bore hole videos.

DR. BURNETT: So if a fracture is healed, perhaps became filled with secondary cement or mineral, would they still show up as a seismic reflection?

DR. MALIVA: Yes, the seismic reflection maps contrasting acoustic impedance between strata. You're looking at the boundaries of formation, but it doesn't provide any information about the actual properties of the formations themselves.

This healing process is very commonly observed. I can cite another example, the Sanibel Island Water Association Well. When we drilled that we found hundreds of feet of breccia there, fractured rock, but it was all cemented. We were worried that we didn't have enough transmissivity for an injection well because this tends to heal over time.

DR. BURNETT: Okay. Thank you. Mr. Quarles, could I ask you also, when you look at this profile, does it say anything to you? Does it say migration?

MR. QUARLES: It does. And the reason it does is any time you see, if you see the yellow lines --

DR. BURNETT: Yes.

MR. QUARLES: They're in the area of this incline which is a bowl-type structure where the bedrock, if you -- let's go down a little bit further. Right there.

All right, so what you see is the density of fractures around that collapsed structure and the faults on both sides. So clearly that deformation has resulted in faults and fractures. Right? So I guess I respond to the comment about the fractures and faults will heal over time. If all fractures and faults healed over time we would never have sink holes in Florida, right? Because they began as a small crack and fission launched on bedrock and solution enlargement made them bigger.

So you can't always assume that a fracture is going to heal. It can turn into conduit type flow. So I'll make that point.

And then, two, let's not forget the extent and distribution of those fractures, vertically and horizontally, are very important when it comes to injection. And Dr. Maliva wrote a report back in 2007 that made that very conclusion, the extent and distribution of fractures are what's important to determine the rate and direction of injected wastewater flow and not relying upon individual data from the bore hole.

DR. BURNETT: Thank you. Could I have Florida Power & Light Exhibit 7, page 3? So this will be another seismic reflection profile. This is from Cunningham also, but it's his earlier paper, 2012. And I'd like to focus on the diagram on the left hand side, if you could extend that? Thank you.

This is from Biscayne Bay, I believe. Yes. And you can see that the author has superimposed the fault line, vertical fault line with the left side going up and the right hand side dropping down, so a normal fault. And if you could reduce the magnification, zoom out? Yes.

So you can see that the fault extends all the way down to the bottom and it extends for thousands of feet.

So Dr. Maliva, this looks like this could be a conduit. It could transport water a very, very long distance if this interpretation is correct.

DR. MALIVA: A fault can be a flow feature. It can be seal. If you're in the gas industry, you find faults that a fault can be filled with less permeable material and actually add value to the flow. Or a fault could be neutral. So there's three options there.

Looking at this, you can't say anything about whether it's a flow feature. As they noted earlier, they had a flow feature at the East Coast Regional Water Treatment Plant that went all the way down. But again, it wasn't an active feature. It's not interpretable in terms of ground water hydraulic properties. You can speculate that it might be a flow feature, but that's not telling you anything about its properties because it could be either a flow feature. It could be a seal. Or it could be a neutral feature.

DR. BURNETT: Is there any geophysical technique that could be combined with seismic reflection to give you hydraulic properties, as well as the structure?

DR. MALIVA: I know some people use resistivity for looking at underground salinity, but probably not on this scale. This is thousands of feet. I can't really think of any technique that would be practical to evaluate that.

DR. BURNETT: Okay. Thanks. Mr. Quarles, does this say anything to you, this diagram?

MR. QUARLES: It does. It says a lot. And you hit the nail on the head in that these faults can extend thousands of feet and breach confined layers that a single bore hole or EPA would even say multiple bores instead of drill through a single point may not illustrate the presence of a fault.

What it says to me is it's a very reasonable explanation for the heterogeneity that has been discussed by Walsh and Price, Dr. Walsh, Cunningham, Dawson, Dr. Maliva, that is the great illustration that is a very plausible explanation of why the previous hydrogeologic investigations have not shown confinement. Or they have, but in fact, there has not been confinement.

DR. BURNETT: Mr. Quarles, changing the subject a little bit, if the wastewater is not used by Florida Power & Light for cooling, it will still be generated at the wastewater treatment plant and disposed of underground. In fact, at the South District Wastewater Treatment Plant, it's one of the sites where some migration appears to have occurred. So isn't it preferable to have some good use made of this wastewater since it will be injected underground anyway?

MR. QUARLES: So I guess I would respond to that by saying Dr. Walsh in Miami-Dade County has probably studied the South District, North District plants more than anybody. Her recommendation is that all future new proposed injection sites have seismic technology in addition to traditional down hole methods. So that's a really good idea. So I don't think it makes sense where you know you've had unintended vertical migration to say it's okay to send it nine miles to the south where we have not had any ground water contamination issues down there. So that's not a good explanation to take it from one place and send it to another that does not already have ground water contamination.

DR. BURNETT: Mr. Quarles, you had

mentioned in your pre-filed testimony that high percent porosity found in the Cave Study, that's the study of the test well, indicates that the bedrock will not be an effective confining layer. But isn't it the case that high porosity can be associated with low permeability?

MR. QUARLES: I'm glad you asked that question. So the other testimonies talked about how there could be high porosities of sand and clay. So when ground water flows through sand and clay, that would be flow through a porous media. So the flow path to go from one side to the other or top to bottom has to go around all of those small particles of soil due to porosity.

So what's different in bedrock is that the greatest opportunity for flow -- it's really an apples and oranges comparison, talking porosity of bedrock, comparing it to porosity of clay because flow through a bedrock, if the porosity is isolated, and focused on a fracture, it would be much faster in a straight line as opposed to going around the individual particles of a clay or sand. Does that make sense?

DR. BURNETT: I'd like to address a question to Mr. Barnhurst. You had stated that staff analysis show that in the absence of enhanced vertical flow features, upward migration could occur, but would likely be limited to 300 feet into the base of the middle confining unit.

So the question is are the enhanced vertical flow features the types of features mentioned by Cunningham and we discussed here this morning?

MR. BARNHURST: So that I think was a general way to describe any feature that can allow for upward migration, so it could be one of the type of features mentioned by Cunningham.

DR. BURNETT: Okay, so it could be.

MR. BARNHURST: It could be. It could also be a well, some type of well failure.

DR. BURNETT: So what if you had included some of those features in your analysis?

MR. BARNHURST: We actually did. We evaluated Florida Power & Light's numerical modeling that was discussed. We performed an independent evaluation. We evaluated three scenarios. One was the potential for ore zone flow, how far might that go. One was the potential for vertical flow, how far might injected wastewater travel vertically through a nonfractured confining unit. And then we assumed the scenario, we used a scenario that assumed a full breach of the middle confining unit full of wastewater up into the Upper Florida Aquifer, the internal impact that might have on ground water quality.

DR. BURNETT: I'll follow that up with -- and you can answer this or perhaps Mr. McNabb. So there were actually two wells drilled, a test well, AW1; and then a dual-zone monitor well. And the question is was the same test conducted on both bore holes? And if they were, were the results similar?

MR. BARNHURST: Who would you like to answer that, Your Honor?

DR. BURNETT: Mr. McNabb.

MR. McNABB: Not exactly all the same tests. For example, on the dual-zone monitor well, we do not collect any cores. There's a reason for that. You focus your core collection in your expected confining interval. We install our dual-zone monitor wells so our upper zone is just near the base, the top of our primary confining unit. So there would be no reason for us to be collecting cores in our monitor well.

Other than that, the geophysical logging program was similar. The Packer testing not as extensive because the Packer testing is primarily in our injection well, we're primarily looking at confinement evaluation with our Packer test. Our

Packer test and our dual-zone monitor well are really more interested in water quality because the design of our dual-zone monitor well is dependent on that water quality with our positioning of an upper zone at or near the base of the underground source of drinking water and our lower zone near the top of our primary confinement unit and below the base of the underground of drinking water.

DR. BURNETT: And another question for you. I believe this is in your report on well EW1. You had estimated that 18.6 million gallons per day would be necessary for cooling using only reclaimed water, but approximately 84.8 million gallons per day when using only the backup saline water.

So it seems like a very large difference from 18.6 to 84.8. Why is it so different?

MR. McNABB: That's based on the water quality of the two water sources. The reclaimed water quality is going to be much lower in total dissolved solids. You can suck cycle it up a few times through the cooling tower before you send it down the injection well. Whereas, when they're operating with a marine -- with salt water, I think it goes through the cycle once and then down the injection well. It's just so saline you don't want to cycle it up much because it starts plating out, precipitating solids in the cooling tower.

DR. BURNETT: Okay. I see. Thank you.

MR. McNABB: Sure. Dr. Burnett, you had previously asked about water quality of the Avon Park Permeable Zone.

DR. BURNETT: Yes.

MR. McNABB: And I said we'd get back to you. Could I address that real quick?

DR. BURNETT: Yes, please.

MR. McNABB: This is based on Packer tests performed on the exploratory well. We don't have one exactly in the Avon Park Permeable Zone, but we have got a Packer test at 1,505 to 1,535. Our total dissolved solids there was 13,890.

Our next one down was at 1,930 to 1,952. Total dissolved solids, 32,167. So it's safe to assume that the Avon Park Permeable Zone is somewhere in between there as far as total dissolved solids.

DR. BURNETT: The first one you mentioned was 1,505 until the second interval?

MR. McNABB: 1,535.

DR. BURNETT: 1,535.

MR. McNABB: That was our test interval for that first test I mentioned.

CHAIRMAN HAWKENS: What was the exhibit number that, Mr. McNabb?

MR. McNABB: That is in the report that I did for the exploratory well. Here we go, FPL-005B.

CHAIRMAN HAWKENS: A couple of follow-up questions. First for Mr. McNabb, the data then, you got the test data from the monitor well. That was not principally for the purpose of designing the confining characteristics of the confining unit. Is that correct?

MR. McNABB: You are correct.

CHAIRMAN HAWKENS: Okay. Thank you. I have a follow-up question also for Mr. Quarles going to porosity. You did state in your initial testimony that high percent porosity is indicative generally of a lack of confinement. Correct?

MR. QUARLES: Correct.

CHAIRMAN HAWKENS: Is it also true that high percent porosity may not represent a lack of confinement?

MR. QUARLES: So the example of clay --

CHAIRMAN HAWKENS: No, no. Can you just answer that question for the data that we're dealing with here from EW1. Is it correct to say that high percent porosity may not be indicative of a lack of confinement?

MR. QUARLES: High percent porosity coupled with hydraulic conductivity and the percent recovery all together suggest that it's not confining in nature.

CHAIRMAN HAWKENS: Okay. So it's fair to say then that the high percent porosity standing alone may not be indicative of a lack of containment.

MR. QUARLES: Correct.

CHAIRMAN HAWKENS: Thank you.

DR. BURNETT: Mr. Quarles, if deep well injection has the kind of problems that you've brought to our attention, what are the alternatives?

MR. QUARLES: Well, in the past if there's been some ocean out faults, surface water out faults. Those have all been used here in the State of Florida in addition to the deep well injection. So now the question is is going forward what is the best way to review and select the site for deep well injection. And the use of seismic technology in addition to traditional bore hole well, drilling, geophysical, all of that when you couple it together, it gives you the best opportunity to evaluate risk, select a site, good or bad, and to have a -- to use Cunningham's word, scientifically defensible investigation that gives reasonable assurance.

I'm not saying that deep well injection is a bad idea. I'm saying just do a thorough site-specific evaluation to give you the best information to make every useable informed decision.

DR. BURNETT: Thank you.

DR. KENNEDY: Just a quick follow-up to that. I'm just specifically what does the seismic reflection study add to the discussion about confinement? Why is that such a significant missing element in this hearing?

MR. QUARLES: So I have the luxury of living in Tennessee where we have bedrock that is exposed at or very near the ground surface. So every day that I drive to school, my son to school or to the grocery, I get to see the heterogeneity of a limestone carbonate formation. I have background education experience in karst geology which is very prevalent, prominent in Florida with sink holes and conduit flow.

The importance of the seismic evaluation gives you a widespread -- to use Cunningham's words -- like it's never been seen before. It gives you a visual observation of the widespread characteristics of the subsurface that would indicate where you would have the highest likelihood of fractures and faults.

If you recall the diagram that had the yellow lines in it.

Single bore hole, even the geophysical, the single borings, the analogy that we use in the world of karst geology is if I'm trying to drill a well into a conduit, I would be no more likely to randomly locate that well than I would if you blind folded me and spun me around and told me to throw a dart at a dart board to hit a bull's eye. It's just a guess.

The seismic evaluation gives you the best opportunity to find these natural pathways of fractures and faults prior to your selection of site.

DR. KENNEDY: And in this case, FP&L has selected a site and they did an exploratory well and it appears from the data that that exploratory well shows a measure of confinement. Is the issue here the extent of the characterization of that site from the one well? As you use in your testimony the word heterogeneity, you indicated that would -- that could exist across short distances, even across short distances.

What kind of distances are we talking about?

MR. QUARLES: I'll give you an example.

I see it every day. And I, as a geologist, imagine when I would drill a hole at this location, I could drill a hole at this point and I would get intact bedrock the whole duration of the boring. But I could move three feet to the left and I could drill a boring and I could get into a six foot open conduit, three feet to the left.

Or I could drill a boring down to 75 feet and hit rock, competent rock. But if I went to 80 feet, I would also, I would have gotten lucky and hit conduit. So single bore holes, the likelihood that you find these natural features is virtually slim to none.

DR. KENNEDY: You're suggesting that the subsurface geology could vary on the order of feet?

MR. QUARLES: It could. For example, if there's a fault there and if you drill here and the fault is five feet over there, you may miss the fault. In karst class structures where you have -- I think I've read where some of these are like three miles in diameter and you would have some fracture there in there associated with that. But you would also have horizontal bedding planes that would be influent for downward pathways. And then you would have vertical joint sets that are vertical fractures that are not displacement faults.

So today, you want to use the best technology which would be combining, incorporating of seismic.

DR. MALIVA: May I make a comment?

DR. KENNEDY: Yes, but let me ask the questions, but I was going to turn to you exactly, to give you, both yourself and the staff to offer their opinions on the heterogeneity of the site or defend the use of one exploratory well.

DR. MALIVA: First of all, this is not Tennessee. This is not even Central Florida or West Central Florida. We don't have well developed karst in the Florida aquifer system. I've been drilling wells here for 20 plus years. We don't find these big solution cavities and caves in the Florida aquifer system in South Florida, south of Lake Okeechobee, totally different geology. So the argument that you can drill here and miss something three feet away is just not applicable.

DR. KENNEDY: Is there something in the record, an exhibit that FP&L or the staff has submitted that could help support the characterization of the geology around the Turkey Point site for its consistency in regard to the exploratory well?

DR. MALIVA: You know it's an issue I didn't think would even be raised, to be honest. I think all of us who are familiar with South Florida geology know that yes, you do get some karstic features in the Biscayne Aquifer, but you don't see that type of structure in South Florida. It's just different geology. It didn't occur to me that I needed to address that issue.

Another comment is you quoted Dr. Cunningham. I've read his papers and I've never seen these quotes, nor did I ever recall Virginia Walsh said all seismic reflection needs to be done for all injection well systems. I don't recall her ever saying that.

This is an ancient deformation structure. It's very widespread throughout Florida. We haven't had in Miami, Broward, Palm Beach County, there's only been three instances where upward migration to a USDW has occurred. And the two, Miami-Dade, North District and South District, there's a very high likelihood that was due to well construction issues.

And another, I think, mischaracterization was of the conclusion of the USEPA and 2005 study. It was recognized at that time that the hydrogeologic demonstration approach, that is, collecting more and more data to demonstrate that you had sufficient confinement so that endangerment of the USDW would not occur, that was recognized to be unsatisfactory. Even if we ran seismic reflection surveys crisscrossing the whole area, you could always still argue that you have this feature three feet away from the seismic profile that you missed.

Instead, the strategy that was adopted was to maintain the current confinement analysis procedures and then upgrade the treatment process. You know, with respect to municipal injections wells, they have the requirement that they go to high-level disinfection as a way of preventing endangerment to the USDW.

The injected water already meets federal drinking water standards. You don't even have an endangerment issue any more, so it's kind of hard to make the argument that even under the worst case scenario that you have migration into the lower USDW, the water would still meet federal drinking water standards. Well, there's not a regulatory issue there. So why would you want to spend millions of dollars to do seismic reflection.

DR. KENNEDY: That's kind of an expansive response. I was going to try to cut you off but you beat me to the punch.

Before -- Mr. Barnhurst, you look like you want to say something. I'd like to go back to Dr. Quarles -- Mr. Quarles.

Two questions come to mind. The seismic reflection thing is probably the single most, I think, disputed topic that we've heard so far today. Does the State of Florida require a seismic reflection study for a new injection well? And if it doesn't currently, are you aware that they're contemplating introducing such a regulation through rulemaking?

MR. QUARLES: I am not aware of any contemplating of a rulemaking change and it currently is not required.

DR. KENNEDY: Okay.

MR. QUARLES: But according to Dr. Walsh and Cunningham, it certainly -- there's an immediate need that it would be useful and beneficial.

DR. KENNEDY: Let me just ask one -- I guess I need a microphone freed up. Maybe Mr. Barnhurst, could you release your microphone. I got it back. Thank you. I'm not getting very good at this.

Just one last question, Mr. Quarles, in regard to permitting of underground injection wells.

Are you aware of any case in Florida where an injection well actually used more than one exploratory well prior to getting their permit? Do you have any example that somebody felt required to do that?

MR. QUARLES: I'm not aware of that. I haven't researched the permit to the other side.

DR. KENNEDY: Fair response. I'm going to release my microphone, but ask Mr. Barnhurst, we had a discussion going here earlier and it looked like you wanted to say something.

MR. BARNHURST: Yes, sir. Hopefully, I can follow the notes I was taking there. Just in reference to I believe the original question was how much geology can vary over short distances in Southeast Florida. The records that comes to my mind, there are numbers of them and based on our review for the final environmental impact statement, the answer is that it doesn't vary greatly over short distances and I think Williams and Kuniansky, I need to look and see if that's one of our exhibits that we filed, but certainly one that we used in the environmental impact statement talks about the fact that the variance in the no confining unit, is that as you travel southeast in Florida, it becomes thicker and it becomes more confining.

Another point, just quickly, if I could make about seismic injection and seismic reflection and the impact it may have on the ability for water to up well. Cunningham himself recognized in the absence of seismic data, there are other types of data to be used to evaluate the nature of the confining unit. In fact, sonic logs bore hole logs are one type of data that you pointed to specifically in one of his reports. That type of data has been collected at the Turkey Point site. We have evaluated it.

In addition to that, the injection well and the observation well which doesn't go through, all the way through the no confining unit, it was used to evaluate the confining nature of the no confining unit through injection pressure testing where you inject into the injection well and you measure any fluctuations in pressure at the observation well. If there were connectivity through the middle confined unit, you would expect to see variations in pressure in your observation well. That's why the well is there. And there was none noted during that pressure test.

CHAIRMAN HAWKENS: Can you cite us to an exhibit number on that, please?

MR. BARNHURST: Yes, I can. The pressure

testing. And perhaps Mr. Thorne can also help me out -- I called it out here. We discussed in the FEIS. I believe it's Section 5.2 of the FEIS, but it's also an exhibit, NRC-055.

If I could just make one more point related to what we've been talking about. As part of our evaluation of the FEIS, we evaluated the nearest possible site that we could that had an abundance of data and that was the South District Wastewater Treatment Plant. There is seismic data at the South District Wastewater Treatment Plant. And the seismic data at that plant indicates that there are no seismic reflection, excuse me, no features that cross cut the no confining unit. There are features there. They're located in the Lower Florida Aquifer beneath the middle confining unit, and yet, there's up welling at that plant.

We may talk in greater detail about why that is, but there's been a variety of reports about evaluating the cause of up welling at that plant and they point to three main issues related to well construction or well corrosion. And so Virginia Walsh in her dissertation which is I think at Exhibit FPL-063 also used isotopic data to evaluate mixing between the different units at the South District Plant and that data also indicated that where you have ammonium which uses tracer in -- because it's part of the injected wastewater, the wells where you saw ammonium were the only wells where you had any type of mixing. And the other wells, it all showed that the water in the different aquifers there at the site was well confined and plotted in different places on that, on the graphs.

DR. KENNEDY: Mr. Barnhurst, I can't let you leave your microphone without telling me what you think short distances involve.

MR. BARNHURST: Certainly short distances -- I thought about that very question this morning. We actually remembered it because we considered it in the EIS. A long distance would be greater than what you would expect to see in and around the site. I think the site is a couple thousand feet across, maybe a little bit more.

I wouldn't expect to see based on the evaluation of geology in Southeast Florida significant differences in the geologic units beneath the site over distances on that magnitude. Even within the distance that the modeling indicates that ground water may move horizontally, which is less than four miles.

DR. KENNEDY: Just out of curiosity, and

I don't know if this should be to the staff or to NP&L, there's going to be more data taken as the injection wells, I guess, are dug or drilled. Is that true?

MR. BARNHURST: My understanding is that each well is subjected to the FDEP UIC which is the Underground Injection Control Rules and Regulations which we've included as one of our exhibits as well.

My understanding is at each location where they plan to do injection each well has to satisfy the requirements of that rule which is for the State of Florida to demonstrate that migration won't occur at that site.

DR. KENNEDY: So if during the injection one of these pathways that should have been uncovered through the seismic study presents itself, what happens? Does anyone know? I mean, does that no longer become an injection weld or does it taint the entire site?

MR. BARNHURST: Based on my read of the FDEP UIC requirements that well would not be allowed to be used for that.

DR. KENNEDY: If one of the wells that was drilled showed a pathway to the upper Floridan aquifer, would that well be used and what does that say about the characterization of the site in general and how does the State of Florida view that?

MR. McNABB: Well, first let me confirm the previous answer. Absolutely DEP is going to make every well stand on its own. Every well is going to undergo the same test and similar testing that we did for the exploratory well.

Now, let me address your question. If it were found that one of the wells had a confinement issue what -- this would be driven by DEP. Once we identified that there is a problem, by rule we are required to inform DEP that we suspect we may have an issue. They would invite us in to have a conversation with them and ultimately I would expect there would be a consent agreement with one of the requirements being remove that well from service.

DR. BURNETT: Mr. McNabb, can you tell us what bit drop is and what it indicates?

MR. McNABB: Could you repeat the question?

DR. BURNETT: In your report on EW-1 you mention the term called bit drop.

MR. McNABB: Oh, bit drop. That would probably be in some of the drill cutting and possibly the core descriptions where the word intra-particulate porosity was probably mentioned which is an indication that we are making note that, "Yeah, it looks like these bores are connected."

DR. BURNETT: So where do you get drop?

MR. McNABB: Oh, is it intra or inter?

DR. BURNETT: No, bit drop.

MR. McNABB: I'm sorry. I'm not hearing correctly at all. I'm sorry. I'm not hearing correctly at all. I apologize. Bit drop. It's something that we really didn't experience in our construction. Bit drop would be an indication of encountering a void during the drilling process.

For example, it's rare, but it does happen when you encounter the boulders occasionally you will be drilling along and all of a sudden the bit will drop four feet. It's very unusual but it does happen in our boulder zone.

But it did not occur at this site. Every single foot that was drilled for that well was hard fought. Never did it occur that they drilled a couple feet and then dropped a couple feet. That just was not happening.

DR. BURNETT: So in the absence of bit drop, is there information you can use to say it's unlikely that there is voids that you're passing through?

MR. McNABB: Yes. Based simply on that you can say it's very unlikely. When you include the geophysical log data, you can say it's extremely unlikely. The geophysical log data would indicate voids.

Our caliber log would show that we have some large cavities. Our bore hole compensated sonic log would indicate the presence of voids as well. We just don't see that. It's not there in the geophysical log data and certainly no one encountered a bit drop.

DR. BURNETT: Dr. Maliva, you had mentioned in your pretrial testimony, and also just a few minutes ago, that it's likely that the migration experience that the South District waste treatment plant was due to well construction issues rather than natural fractures. Can you explain why you feel that way?

DR. MALIVA: Okay. Well, there were several isolated plumes of upward migration at this site. If you had unfavorable geologic conditions where the combining zone was fractured, you would expect the upward migration to be everywhere.

You wouldn't have a situation such as

observed there in a dual-zone monitor well where you didn't see anything in the lower zone but you saw it in the middle ground. It's just not a pattern that you would expect.

There was one area there in the boulder zone, BZ well cluster, where it's unequivocal there was a casing failure there and upward migration. Everybody who has looked at this site, you know, Walsh and Price, USGS, the data is suggestive of well construction but it's not unequivocal.

The geochemical data alone cannot say one option to the other. To me the fact that it's isolated plumes around wells and, again, in some wells one zone is a shower zone, is imperative but not a deeper zone when you expected geologic conditions would all move up uniformly. I think it's highly suggestive of well issues.

DR. BURNETT: Is there something different about the way that wells are constructed today and they were constructed when those wells were dug?

DR. MALIVA: Oh, very much so. I think the experiences at South District sort of prompted changes in well drilling practices. One of the suspected cause of problems was you drill a pilot hole first to the total depth and then afterwards you would read it.

If those two holes are not -- don't coincide, you can leave the vertical conduit. The pilot hole may still be open and then you main is shifted over in another direction. Based on some of these concerns probably starting in 1980s, 1990s we now cement up that pilot hole before we read.

Another construction change is for any casing we have a dual-zone monitor where we now use fiber glass tubings instead of steel, more corrosion-resistant materials. Certainly any process with the UIC program over time you like to think you progressively do things better and learn from some past lessons.

DR. BURNETT: One more question on a different matter, In Virginia Walsh's Ph.D. dissertation she suggested that CO2 enriched injecting could increase the porosity of the injection zone by dissolving some of the limestone. What do you think about that idea?

DR. MALIVA: It's basic geochemistry. Carbonate solubility increases the PCO2. To improve the performance of wells we actually intentionally inject CO2 into it. We believe that's a good thing if that happened. It would increase the permeability.

I don't think it would ever occur to the extent that it would compromise the injection zone.

Ideally you want your injected fluids to be slightly under-saturated with respect to calcium carbonate because you don't want the reverse process of calcium carbonate scaling to occur. Ideally you want to be slightly below calcite saturation just to prevent a scaling problem.

DR. BURNETT: Thank you. That's all.

MR. QUARLES: Is it possible that I might be able to offer a couple more comments that would respond to the last two questions?

DR. BURNETT: Yes. Go ahead.

MR. QUARLES: So the question is whether or not you can blame leakage on faulty well construction versus a natural geologic feature. I haven't seen any proof other than one example of a casing of a well that was improperly constructed or corroded or something happened that perhaps failed.

Maybe it wasn't deep enough but it was blamed on some vertical leakage. Initially, for example, at the North District plant back in 2010 it was believed or suspected that a faulty well was to blame for the upward migration there. Dr. Walsh's dissertation concluded that was not -- that did not occur. That is not to blame.

Dr. Maliva wrote a report again back in 2007 that at least back then that there was -- he commented that there was no proof that faulty well construction could be blamed for the upward migration so I haven't seen any new proof.

I disagree when Dr. Maliva said everyone has looked at the South District plant. Their opinion suggested it's a faulty well, I can tell you that. The Star reports back in 2001 suggested either a faulty well or a natural feature.

These multiple plumes that have occurred at the South District plant can happen and it doesn't surprise me that you would have multiple plumes if you have fractures, multiple fractures. Again, fractures joint steps typically can be parallel and closely related to each other.

That could easily suggest why you would have multiple plumes in addition to multiple bypasses that are not seen in a monitored well that is deep, but yet you see them in shallow wells.

The other thing that I would add is that, again, the CO2 enrichment is very clear that it can create new pathways as well as in large existing pathways according to Dr. Walsh.

DR. BURNETT: Thank you.

CHAIRMAN HAWKENS: Given that the NRC staff has ultimately responded here, would you like to respond to what Mr. Quarles just said?

MR. BARNHURST: Yes, I would. Thank you. We looked at everything we could get our hands on about the South District Waste Water Treatment Plant. We considered the experience there to be very informative as we considered what would happen at the Turkey Point site.

Just two points. Virginia Walsh is, indeed, the expert at what has occurred there. I'll say in her -- I think it's her 2010 report -- I was just looking for that -- she mentioned there is no indication of fracturing in the middle confined unit at the South District Waste Water Treatment Plant.

There was evidence of three different types of either well failure that Dr. Maliva talked about, too. One additional one is one that Ms. Walsh mentions. It's from a report by McNeill in 2002 we included as Exhibit 64.

It's the 10 of 17 wells that were installed at one time at the site were drilled through the most significant portion at the confined unit and then cased, I think, about 500 feet above that confined unit. As they injected, they injected directly into the confined unit rather than the injection zone. It's not something that proves absolutely what the cause is but I think it's a really good indication.

Another point I just wanted to make quickly from Dr. Walsh's thesis which, again, is FPL-62, is on page 159 she says, "No evidence of upper migration of injected was observed in any wells in the upper Floridan aquifer at both sites -- both sites meaning the North District and the South District -- based on ammonia concentrations to stable isotopes, tritium, and dissolved gas data."

So what I think is interesting about that is that despite the fact that for whatever reason upwelling has been noted to occur at the South District and the North District site, it had not entered the upper Floridan aquifer according to her chemical analysis.

MR. QUARLES: Can I respond to that?

CHAIRMAN HAWKENS: Before you do, I have a follow-up question. FPL Exhibit 0063, which is the Walsh dissertation, also says, and I quote, "Seismic data acquisition is recommended for any future injection sites as it may be able to optimize the location of future injection sites in areas where subsurface features are not found." I'm wondering if -- first, I'll ask Dr. Maliva to respond to that particular statement.

DR. MALIVA: Well, I mean, first that's one person's opinion. I think when you talk about seismic reflection you have to understand, too, there's only certain areas where you can practically do it. It is not something that you can realistically do anywhere, particularly in developed area.

The seismic reflection --

CHAIRMAN HAWKENS: But it's not your position that it can't be done at Turkey Point, is it?

DR. MALIVA: I'm not sure if it can to be honest. You need to have a deep enough canal nearby to allow a fairly large-size boat with all the equipment to pass through and you need to have proper canal bottom conditions so it's not clear to me that it is, in fact, possible to do there.

Even if it were, the USGS did their seismic reflection. They did it offshore or on some of the major canals so unless your injection well just happens to be there, you know, a fairly deep enough canal that you can bring all the equipment in, it's not practical. Doing it on land obviously in a residential area you can't start setting off explosions and doing seismic --

CHAIRMAN HAWKENS: Let's assume that it could be done at the Turkey Point site. At the end of the day is it just that you and Dr. Walsh have a professional disagreement on whether these tests should be conducted?

DR. MALIVA: I mean, I would disagree with her on that. I mean, I think decisions on half of her characterization methods you need to look at the cost of information versus the value of information. We know that running seismic reflection is very expensive to do. I believe that the total budget for the USGS project for the North and South District, and also included some modeling, was over $12 million. This is not a trivial exercise to do.

So what is the value of this information? If we were to run this and found some sort of deformation structure near where we wanted to install our injection wells, I don't think it would be sufficient reason not to proceed with the project.

Again, because I give an example of the East Central Waste Water Treatment Plant site where we had a structure going right through and there was no impact on it. It's not going to lead to an actionable decision on whether to go or no go on it.

What is the real value of doing it? It's great academic interest. You can really see this episode in the history of Florida he wouldn't tell you no, don't do injection wells near Turkey Point.

CHAIRMAN HAWKENS: All right, thank you.

Mr. Barnhurst, do you have anything to add to that? Or Mr. Thorne.

MR. BARNHURST: I guess my response would be a little bit different in that the staff's responsibility underneath is to consider the best available information. That information was not available at the Turkey Point site so we couldn't consider it at DIS.

We consider it a kind of snapshot in time so as we performed our evaluation we looked at the wealth of information that was out there. If, indeed, we thought FPL needed to have obtained that data at that site, that's not something that we could under the NEPA process which is we do an evaluation and disclose the impacts.

CHAIRMAN HAWKENS: Although under NEPA, and I understand you're not the staff's attorney in this case, but is it your understanding that under

NEPA the staff is required to take a hard look?

MR. BARNHURST: Absolutely.

CHAIRMAN HAWKENS: And if you determine that a hard look is required of this seismic information, wouldn't you require it for part of your NEPA analysis?

MR. BARNHURST: Maybe this is where I do defer to my attorney because I'm not sure what our legal capability to have that -- to require that kind of information. I will say that we didn't feel like it was needed in this case to make an impact determination because our impact determination didn't rely solely on the fact that the injection well may or may not be confined within the boulder zone although we did evaluate that.

CHAIRMAN HAWKENS: All right. Thank you.

Mr. Quarles, you may have the last word unless we decide afterwards that you don't get it. What do you have to say?

MR. QUARLES: So let me respond to a comment about Dr. Walsh's report, dissertation saying that there's no demonstrated occurrence of contamination reaching the UFA. It's very important there's about four or five words in that report that talk about -- she clarifies that statement to say that it could be the result of perhaps wells that are in the UFA above an injection well site are not properly located to detect contamination in the UFA if it occurred. Right?

Secondly, I'll add to that because when you look at historical discussions about upper migration, the most common zones that are monitored, there are three of them. Top to bottom the MC one which is the upper confined layer above the Avon Park Permeable Zone. The Avon Park Permeable Zone itself is number two. Then number three is the MC2.

What has been demonstrated is that ammonia levels have been found in MC1 above the Avon Park Permeable Zone. What I have not seen is any discussion about the commonality of having monitoring wells and lots of them, there are several of them, in the UFA.

If you don't have wells in the UFA, and Dr. Walsh pointed that out, that the wells whether they are there or not, they may not be adequate to conclude that the migration has not made it through the upper confined level into the UFA.

CHAIRMAN HAWKENS: Thank you.

DR. KENNEDY: Just a couple closing questions. Dr. Maliva, in your pre-filed testimony, which is FPL Exhibit 003 on pages 10 through 11 you speak very confidently that there is no firm evidence, and I'm quoting "of unrecognized culture fractures extending upward from the boulder zone that would allow for vertical migration of fluids into a USDW at any injection well site in South Florida."

Couple of questions. What is that bold statement based on and did I accurately -- maybe first did I accurately capture your statement and then, if that is accurate, what is that statement based on? It seems quite broad.

DR. MALIVA: You know, we have -- there has only been a small number of sites in South Florida where migration into the USDW has happened. All these sites have been investigated. There has been no study or evidence or any suggestion by anyone that it was related to a fault.

DR. KENNEDY: So all of those instances were related to faulty wells?

DR. MALIVA: No. There are some wells sites where the geologic condition just turned out not to be favorable. It was quite evident in the data that was collected during construction. A good example would be the DV Lee well in the Melbourne, Florida area. It was simply fractured. That was amply evident in the geophysical logs.

Again, I don't know of any instances where somebody found a fault or any other structure and has been able to relate upward migration to that. I mean, they did the seismic. If there is information, I haven't seen it and I've investigated in detail.

DR. KENNEDY: Mr. Quarles, would you like to have the last word on that topic?

MR. QUARLES: Well, it may not be the last, of course. We might keep going but, you know, the bottom line is EPA has acknowledged that the geology of Southeast Florida is very complex and likely the result of these upper migrations.

EPA and everybody else has talked about and written about instances of migration into USDW and/or unintended migration whether or not it went to a USDW or not. If you look at the 1718 side stat that's reported, a fairly large percentage of those, I don't remember exactly, but maybe 35 percent or so are in Southeast Florida. It underscores the importance of knowing what you're doing in the unique geology of Southeast Florida.

What I've read and the people who talk about the reference reports whether it's Cunningham, Dausman, Dr. Maliva, it's all about the extent and nature of the fracture. When it's all said and done I haven't seen a report that really put the widespread blame on a faulty well.

DR. KENNEDY: Is one of the take-aways here, and I guess I'm picking up a little bit on what Dr. Maliva just said, is if you properly site the injection well you have a higher chance of success of no upper migration?

MR. QUARLES: That's exactly right. Cunningham would call that scientifically defensible for a reasonable assurance. I think at the end of the day all you can do is the best that you can do using the most available readable technology to make that choice for site selection.

Like Dr. Walsh said, the usefulness of seismic would perhaps eliminate a site from being a potential site as opposed to let's just take a well out of service, you know, if we find a feature that we got lucky and hit.

DR. KENNEDY: Thank you. One last point of clarification. This is going to be a reading test for me. I noted in Dr. Maliva's pre-filed testimony that -- I'm using FPL-002 and PDF page 9. If you want to display it, we can test my reading if that's possible. 3, I'm sorry. Just in case we need the reference.

What I'm looking for is a statement that puts the top of the upper Floridan aquifer at a depth of 2,915. Maybe it was 002. I don't see it there, Andy. I wrote down 2 but you convinced me 3 because I have 3 on the next question. Let's try page 9. I'm ready to withdraw my question. Right there. Okay. Go down just a little bit more. Right there.

"Between the base of the USDW at a depth of 1,450 feet and the top of the upper Floridan aquifer at a depth of 2,915 feet." I'm wondering if that should be the top of the lower Floridan aquifer as opposed to upper. Again, only important if we need this dimensioning sometime in the decision.

MR. QUARLES: That should be lower Floridan aquifer.

DR. KENNEDY: Sorry to take us through such painful -- I was just curious. I felt that was the right answer.

MR. QUARLES: That is a typo. It should be lower Floridan aquifer.

DR. KENNEDY: We'll take it as a typo. Thank you.

CHAIRMAN HAWKENS: That concludes our questioning of Panel 1 on this topic, for the time being anyway. I suggest that we take a recess for lunch. I would propose an hour and 15 minutes unless you would like to cut it down to an hour. Let me poll the council.

MS. CURRAN: Judge Hawkens, we don't have any idea how long it takes to walk to where we can get a sandwich. Is it pretty close by?

CHAIRMAN HAWKENS: No, I'm not from this area so I can't tell you.

MS. CURRAN: Well then --

CHAIRMAN HAWKENS: We can go for an hour-and-a-half and it will give you some time to unwind.

MS. CURRAN: I think that would be a better idea. Thanks.

CHAIRMAN HAWKENS: NRC staff, an hour-and-a-half. Is that satisfactory with you?

MS. WRIGHT: That's fine. We don't have a preference.

CHAIRMAN HAWKENS: Okay. FPL?

MR. LEPRE: That's fine with us as well.

CHAIRMAN HAWKENS: All right. I have that it's 12:40 now. We'll resume at 2:10. We'll be in recess until 2:10. Thank you.

(Whereupon, the above-entitled matter went off the record at 12:40 p.m. and resumed at 2:10 p.m.)

CHAIRMAN HAWKENS: Please be seated and we'll resume in just a few moments. This afternoon, we're going to start with Topic 2.

And in Topic 2, we will discuss the ability of well construction procedures and technology to prevent upward migration of wastewater to the Upper Floridan aquifer due to faulty well construction or well deterioration over time.

I note that the witnesses for Topic 2 are the same as they were for Topic 1, but would you please introduce yourselves once more for the record, starting with Joint Intervenors?

MR. QUARLES: My names is Mark Quarles.

DR. MALIVA: My name is Robert Maliva.

MR. McNABB: My name is David McNabb.

MR. THORNE: This is Paul Thorne.

MR. BARNHURST: My name is Dan Barnhurst.

CHAIRMAN HAWKENS: Thank you. And observing that the witness, witnesses on Panel 2 are the same for Panel 1 before we embark on our Panel 2 questions, Judge Burnett has a couple of questions from the first topic that we discussed this morning.

DR. BURNETT: Mr. McNabb, I asked you about this this morning, but I want to, we still need some clarification.

This concerns the point at which the main confining layer begins at Turkey Point. We have seen that, in most cases, 1,930 feet below surface is the indication.

But twice in the W-1 report, 1,980 was mentioned. And twice in the FEIS, 1,980 was mentioned, 1,930 feet below surface is mentioned most of the time. But there are these other mentions of 1,980.

And it's a small difference, but in fact, it does chance the number of Packer tests in the main confining level, whether it's 1,930 or 1,980.

So, if we could ask you, you don't have to search for it now, but if you could reconfirm to us which of those two is the number that everyone is using.

MR. McNABB: I can do that.

DR. BURNETT: Or the one that you think is most accurate.

MR. McNABB: I can do that right now, and that number is 1,930.

DR. BURNETT: Okay. So the 1,980 that shows up is a typo, perhaps? Or --

MR. McNABB: Perhaps.

DR. BURNETT: This is the standard?

MR. McNABB: I would like to see its use, but perhaps it's a typo. But 1,930 is --

DR. BURNETT: Okay, fine.

MR. McNABB: -- top of confinement.

DR. BURNETT: Thank you. And I wanted to question Mr. Quarles. And another clarification for Mr. Quarles.

You were talking about monitoring in the Floridan aquifer, and when we were discussing over lunch, some of us thought that you may have said that in the, in the Walsh study at the South District and North District wastewater treatment plant, that they did not have any monitor wells in the, in the Upper Floridan aquifer. Did you in fact say that?

MR. QUARLES: What I said was that Dr. Walsh, she made a comment about whether or not upper migration into the UFA had occurred, and that she said there was no indication that it did.

But perhaps the reason there's no indication is that it may be well placement that is not adequate to determine whether or not the migration in the UFA occurred.

DR. BURNETT: Okay. So you were indicating placement of the monitor wells --

MR. QUARLES: Correct.

DR. BURNETT: -- just may have missed --

MR. QUARLES: Right.

DR. BURNETT: -- perhaps. Okay. That's fine. Thanks very much.

CHAIRMAN HAWKENS: We'll now, we'll now proceed to questions on Topic 2.

TOPIC 2 QUESTIONING

DR. KENNEDY: I've been practicing microphone technology. Hopefully it'll get better in the second half. So this set of questions is directed at well construction.

In general, reviewing the pre-filed testimony, well construction procedures and technologies credited to prevent wastewater migration from the Upper Floridan aquifer. This is repeatedly referred to as modern well technology.

I'd like to start with Mr. McNabb, and is it FP&L's position that current well construction techniques has a role in preventing upwelling of the wastewater to the UFA?

MR. McNABB: Yes, absolutely. The proper construction techniques will prevent fluid migration. And those techniques, what's changed when we say modern, with really, what we're really getting at there is, we are backplugging our pilot holes that are through a confinement, with cement.

DR. KENNEDY: So is that the biggest why you believe that it's a preventative technology? Is it the backfilling of pilot holes?

Or is there, is there other significant improvements that you'd like, that we should be aware of?

MR. McNABB: Really the primary item is the backplugging of the pilot holes with cement. There have been maybe a few newer logs that have come in, but they really haven't had a large impact in, what should I say, making sure that everything is constructed properly.

It's really through our proper cementing techniques, our proper testing to evaluate the geology.

Running these items past DEP, we have to make recommendations to DEP with regard to where we set casings, where we monitor, set our monitor zones.

What, I'm really hanging my hat primarily on the backplugging of pilot holes, because I believe that is the primary source of fluid migration.

DR. KENNEDY: And this backplugging, does that take the pilot hole, prevent the pilot hold from being a bypass to the Upper Floridan aquifer from the boulder zone? Is that the intent of it?

MR. McNABB: Indeed, it is. The intent is to eliminate that pilot hole, return it to nearly pre-drilled condition.

DR. KENNEDY: So this backplugging turns the pilot hole into impenetrable or impermeable zone?

MR. McNABB: Impermeable is probably a word I'd want --

DR. KENNEDY: Okay.

MR. McNABB: -- to be careful of. But yes, it prevents the fluid migration up a conduit.

DR. KENNEDY: Okay, thank you.

MR. McNABB: Sure.

DR. KENNEDY: When were these changes to well technology introduced?

MR. McNABB: I would estimate the late 1990s.

DR. KENNEDY: And what precipitated a change in well technology? I think this may have been asked this morning and answered, but I just, to put it together here in the regular --

MR. McNABB: Well, I believe that people started realizing that these double pilot holes were something that could happen.

Actually they had been observed on a video during the well construction where they were doing a video and they were surprised to see, whoa, look at this.

The ream hole actually walked off the pilot hole. So now we know that this can happen, let's prevent it.

DR. KENNEDY: Okay. Thank you. Staying with Mr. McNabb, are these well technology improvements, the improvements to well technology, are they voluntary or mandatory? Is this something the state of Florida regulates?

MR. McNABB: There's no rule requiring the backplugging. So it's not required. It is voluntary.

DR. KENNEDY: So would you call this the best practice? Or, I mean, there's no reason you have to follow it, I guess, is what I'm hearing.

MR. McNABB: There's no reason, although, this is suspicion, during the permitting process, I suspect that if my application did not indicate I was going to backplug pilot holes, I would expect an RAI question regarding it.

And it would probably come back again unless I said, we're going to backplug those pilot holes.

DR. KENNEDY: So is it the intent as you move forward in developing the remaining injection wells and monitoring wells, that any pilot holes would be backplugged?

MR. McNABB: Any pilot hole penetrating the confining interval, yes.

DR. KENNEDY: Okay. Very good. That's for the clarification. How much, well, how much industry operating experience, I guess you said they were introduced in 1990. Do you have any sense of how many years of injection well data there is with the new technology?

MR. McNABB: Well, I would, I would estimate, if I go late '90s, then I would guess that we've got about 20 years of data using the new technique.

DR. KENNEDY: And I guess, can you speak to the operating history with the report, I guess we've used the word faulty wells.

And maybe we could later talk about what a faulty well is. But has there been any evidence that this new technology has led to any faulty well conditions?

MR. McNABB: Not that I'm aware of.

DR. KENNEDY: And I guess with that, I

guess I can turn to Mr. Quarles. If he would want to have a counterpoint to what you just heard about well construction and the plugging, backplugging of the pilot holes, if you have any counter-position. This is a good time to speak.

MR. QUARLES: And clearly, you know, let's back up. Every well that was ever drilled as an injection well in the state of Florida was approved by someone, and it was state of the art at the time.

So clearly, the procedure that was used back then was approved and certified by several people. All right.

So here we are, I guess the big concern is that even though, according to Mr. McNabb, that the industry has recognized that this is a problem.

They haven't changed the rule to require backfilling, backplugging of that pilot hole. So I guess that's, you know, first comment.

So it lead it up to the discretion of the person drilling the well. Backfilling, backplugging is a great idea that should be done. Absolutely. So I fully support that.

DR. KENNEDY: Do you have, I didn't take, I didn't practice enough. Do you have any reason I believe, I mean, we just heard Mr. McNabb say that it is their best practice and their intent to use it going forward. Is there any reason to believe that they wouldn't heed that position?

MR. QUARLES: When you say they, yes.

DR. KENNEDY: FP&L. In the injection wells that they will be potentially developing over the next years.

MR. QUARLES: There's no indication that, according to these guys, that they're not going to institute the backfilling practice.

DR. KENNEDY: If they do the backfilling practice, do you have any additional concerns about well technology that we should be aware of?

MR. QUARLES: Well, I do. There was a, I think it was the city of Sunrise, where it was, there was some leakage that was attributed to faulty well construction.

So the pilot hole is not the only way that a well can leak. If you set the surface casing, the protective casing that's drilled into the confining layer, if you miss it, if you, if you drill it too shallow and set it too shallow, there are other ways that a well can become a pathway.

DR. KENNEDY: Maybe it's a good time to, because the word faulty well is all through the testimony.

And I'll give you a first shot at characterizing what would constitute a faulty well. I mean, we've talked about a pilot hole, which I envision to be a bypass of the, a bypass pathway.

And there, you just alluded to other potential mechanisms to constitute a faulty well or leakage into the environment.

MR. QUARLES: So they talk about the pilot hole. If a the cementing of the pilot hole, what happens is, when you go to fill the bore hole full of cement to seal it, you're making a calculation of how many gallons of grout you're going to inject into the ground based on the diameter and the depth of the hole. All right?

So then you say, the rule of thumb is you want to make sure that you put more grout in there than what your calculation suggests. So it's a grout balance.

So you're assuming that the grout that you inject is going and filling in the right hole. Plus you're going to lose some grout into the cracks adjacent to the bore hole. All right?

So it's not a perfect science, but that's what you can do because you don't have eyes and ears that are down the hole.

Where you set the casing into the confining layer is very important because that, and that's based upon your hydro-geologic characterization where you determine where your primary confining layers are.

So you have to know where those are so that you know how deep to put your protective casing. All right?

And so then, so then you inject grout around that. And you're doing a very similar grout calculation to make sure that you're cementing those casings in place.

And so you're assuming that the amount of grout that's going where it's supposed to do and completely surrounding your protective casings.

The mechanical integrity test that they would do, they would also try to demonstrate that cement is in fact all the way around the protective casing.

So it's a complicated process to drill a deep well and to make sure that you've got all of these telescoping layers, or intervals of pipe are sealed in the proper locations.

DR. KENNEDY: Is the mechanical integrity testing, and we'll get to a little bit more of that later on. Is that the only potential testing that would be useful in establishing integrity of the well?

MR. QUARLES: They've also discussed a pressure testing. It's very common.

DR. KENNEDY: Thank you. Mr. McNabb, I'm sure you would like to provide some argument to this as well.

MR. McNABB: I would. Regarding the, what he referred to, or what I refer to as short casing where you, indeed you set that final casing too shallow.

We need to get our final casing approved by DEP. They've learned from these mistakes. They make us set it within, certainly within 50 feet of the top of the boulder zone.

Typically we're setting it within 20 feet. You won't get it approved unless you're setting casing, you know, right on top of your boulder zone.

With regard to this many, the backplugging of the pilot hole. We're not dependent upon any cementing volume or calculations.

What we're doing there is, we are pumping, we look at the caliper log and say, okay, we want to bring it up 200 feet.

That's equivalent to, say, 300 barrels. We pump that 300 barrels. We give that cement time to set up.

Wait until our, we collect a sample and have that on the surface. We look at that sample on the surface. When that sample is hard, we know we can go in and tag it and expect the cement to be hard.

So we go in and physically tag the top of the cement. So we don't anticipate where the top of the cement is.

We can't make any mistakes because we're going in and actually tagging it. When we, when we're cementing casing in place, remember that cement, there is no grout. This is not concrete. This is cement.

It's just a slurry, and it's very, very, a low viscosity fluid, and it's tough to imagine that you could cement one side of the casing and have 200 feet of liquid cement on one side of the casing without it falling down and filling in the entire circumference of the casing.

Another case where we're very cautious, when we're cementing those casings, we first of all, first thing we do after our cement stage is go in and run a temperature log, and we run that temperature log to get an estimate of where the top of cement is.

You know, and do the, you know, hydrations and where the temperature is valuable. We then go confirm it with the physical tab with our cement running, and actually go down and tag that to confirm that depth. So we're very cautious not to leave any voids.

DR. KENNEDY: Can you give me a little better sense, I guess tagging is sort of not, I guess as a nuclear engineer, I don't, tagging things, I'm not sure what, I'm not sure we're doing the same tagging you're doing.

MR. McNABB: I'm sorry. I use these well terms too loosely, I believe, sometimes. Tagging, what we're doing is, when we're cementing, we're cementing through a cement train.

It's usually a 2 3/8 inch diameter cement line that we actually, they're in 30 foot joints. You have to screw them together and keep on lowering them down on the back side of the casing where the cement is. And we lower that down until we actually hit the top of that cement.

So we can actually, that's the physical tag of the cement. And we, again, we're, before that, we're doing that temperature log.

We're making sure that these, that the

information is consistent between the two so that we don't get fooled.

DR. KENNEDY: So it's like, tag, you're it.

MR. McNABB: Yes.

DR. KENNEDY: So you touched a --

MR. McNABB: You got it.

DR. KENNEDY: Is that, is that, it's a physical, as far as sensing that you hit the concrete, or hit the bottom?

MR. McNABB: That's correct.

DR. KENNEDY: Okay. Thank you.

DR. MALIVA: May I briefly just add one point? This whole process is very rigorously overseen by the DEP as well as by the engineers. There's continuous onsite supervision.

You know, as far as issues like cementing the pilot hole, that is required in the technical specifications that are prepared.

So it's not something that is left to the option of the well driller. And each step along the way, there's, you know, David or whoever is the engineer of record, you're required to provide documentation, you know, come up with a, you know, make a strong technical case of where you're going to set your casing.

You have to do all of the mechanical integrity testing, provide a detailed analysis of that data to demonstrate that the well does have mechanical integrity testing.

Drilling a deep, a classical injection well is very different from any other drilling job in terms of just the rigorous oversight there is. And both the engineer's, the owner's representatives as well as the DEP.

DR. KENNEDY: You're alluding to specifications and such. Is this well cementing process, is there a procedure for it?

Is it something that's been developed over time and, you know, based on experience and testing and operating history, it has grown into a less science and more factually-driven from experience?

DR. MALIVA: Oh, very much so. You know, every time a write a drilling, specs from the injection log, you learn from lessons of the past and I think we even tie the, every step of the way there's detailed instructions about how things should be done.

DR. KENNEDY: Are those procedures or instructions, are they previewed with the Florida Department of Environmental Protection?

DR. MALIVA: Oh, very much so.

DR. KENNEDY: So they --

DR. MALIVA: That's part of the application to provide detailed specifications. And they go over it page by page. If they have any questions or comments or requirements --

DR. KENNEDY: So they have an oversight and review role?

DR. MALIVA: Very much so. You have to report to them on a weekly basis on what's going on, drilling progress, what you've done this week, what you plan next week, the results of any testing during that one week, that previous week period.

You need to provide them copies of all of the geophysical logs run. It's a very rigorous oversight procedure.

DR. KENNEDY: All right, thank you. This makes me wonder, and I'll start with Mr. Barnhurst, but you can hand it off to your colleague there.

But I'm curious what role the NRC staff plays in this cementing of the injection well, if any. Is it, is there any oversight role? Do you, do you get involved at all?

MR. BARNHURST: It's part of preparation to the environmental impact statement we learned. We weren't there onsite the day the cementing happened, but we did throughout the preparation of the draft environmental impact statement.

And we go to the site and we visited the trailer and we talked to them about the different requirements that they had to follow as they installed the well.

The other thing that we did as part of preparation to the environmental impact statement is to review the actual Florida Administrative Code, which is 62-528, and it's NRC 019, is the exhibit that talks about all of this. And so we were, we became familiar with what was required by the state of Florida.

DR. KENNEDY: Okay, just out of curiosity, is there any credit taken, and maybe you just answered, what credit is taken for the well technology in evaluating the environmental impact of, say, a faulty well at Turkey Point?

MR. BARNHURST: The credit taken for well technology, and I think that we, as part of review, and Mr. Thorne can certainly jump in, just want to ensure that the best practices are being followed.

And so as we're, you know, as we're evaluating the Florida Administrative Code for all of the different requirements for, I got monitoring well construction standards in front of me right now.

It's an education to us about what they have to do in order to get their permit. And then we, during preparation to FDIS, received a copy of that permit to verify that they had indeed received that permit from Florida in order to assure that these things had been all to the satisfaction of the Florida Department of Environmental Protection.

DR. KENNEDY: Is it, is it fair to say, or is it an overstatement to say that in your assessment of the environmental impact of the potential upwelling of wastewater into the potential source of drinking water, did well technology play any role in that assessment?

MR. BARNHURST: So one part of our analysis, we evaluated the confining ability in the middle confining unit.

And as we talked about earlier today, one of the reasons why you may have a lack of confinement is because of issues with well construction or failure over time.

And so certainly that's something that we, that we were mindful and evaluated as part of our preparation of our environmental impact statement.

DR. KENNEDY: All right, thank you.

MR. THORNE: Yes, I might add --

DR. KENNEDY: Go ahead.

MR. THORNE: -- a couple of things. We, even at the very beginning of the EIS process after the audit, the staff met with people from the UIC, Florida UIC Department to discuss what the requirements were and what some of the issues were.

So it's something we've been looking at, you know, through the whole process developing the EIS.

And also when they were drilling exploratory well, we reviewed the daily drilling reports and the reports that were issued by FDL's contractor's to make sure we understood how the drilling process was going and what the requirements were and what the design and technologies that would be used to, would be to be sure that they would provide adequate seals to prohibit upwelling.

DR. KENNEDY: But is it, is it fair to say, I guess what I'm trying to get to is, you know, there's been a general conclusion drawn that the environmental impact would be small.

And I guess I'm really probing to see if the well construction and the well technology has any role in assessing that impact as being small?

MR. THORNE: I think it has a role. I mean, there might be other factors as far as the nature of the wastewater and, you know, other things that would also come into play.

But I think that, you know, it's another piece or anything kind of layer of protection I guess for the, for the groundwater supply are these EIC requirements.

So we take those seriously and feel like we need to understand that make sure that that provides the type of confinement that state officials are looking for, so they can assess that.

DR. KENNEDY: All right. Thank you. Thank you.

MR. THORNE: Okay.

DR. KENNEDY: All right, change of subject just slightly, but still talking about wells and faulty wells.

In the staff's rebuttal testimony, and NRC Exhibit 072 at Pages 22 and 23, a statement is made that the claims of upwelling can be attributed to faulty wells. I guess I'll turn to Mr. Barnhurst, but again, you may hand it off to your colleague.

We just, I think we're going in

alphabetical order. There's got to be some indication here.

MR. BARNHURST: I should change my name.

DR. KENNEDY: So why does the staff believe that the noted potential upwelling is due to faulty wells?

MR. BARNHURST: So I think, as it's been pointed out earlier, there are a number of different studies that were referenced in the environmental impact statement and as part of this proceeding that talk about potential causes of upwelling.

That statement is based on my professional opinion, based on what I've, what I've read, reports that talk about the three different types of potential well-related upwelling that can occur.

And also a knowledge of the reports of the, of the geology that we reviewed indicating what features may or may not occur at the site. And so I think specifically for the South District wastewater treatment plant, which is --

DR. KENNEDY: Okay.

MR. BARNHURST: -- which is what is being talked about there, in short, as I reviewed Cunningham, there's our seismic reflection lines that go north of the site and south of the site, and there were no course collapse features in the unit, other than the Lower Floridan aquifer, according to this seismic, that seismic reflection data.

Virginia Walsh concluded that the middle confined unit at the site was not fractured. And so without either of those nature mechanisms for, to create upwelling, you're left with widespread reports of well issues at the site. And so really that's my professional opinion based on, based on that.

DR. KENNEDY: All right. The Intervenors had a similar, contradictory opinion, which is in their Exhibit 22 at Page 16.

And Mr. Quarles, you state, the FEIS incorrectly attributes vertical migration of contaminated wastewater to faulty wells rather than geological conduits.

And I think we've been down this path a few times. It may be a good time to sort of summarize here why you believe that this noted upwelling is not due to faulty wells?

MR. QUARLES: You know, you could, you could start back, as far as the start of 2001 and recently the Walsh and Price, 2010 where there was some suspicion at the North District plant that it was related to a faulty well that was then disproved by

Dr. Walsh and her dissertation in 2012.

Bottom line is that they've all discussed possibility of a faulty well and/or natural features. And lots of people have done these research investigations to try to figure out what the cause is, and I haven't read any of, any of these, you know, published documents that proved faulty wells are the cause of these multiple sources of plumes at the South District plant.

You know, in fact, like for example, at the North District plant, it was thought it was a faulty well, but Dr. Walsh concluded that it was actually a natural feature that was offsite.

You know, the contaminated plume migrated offsite to the vertical feature, and then migrated with the direction of regional groundwater, flowed back to the site.

So you know, the documents that I read that they cited as well, you know, pointed my opinion more to these natural geologic features as opposed to faulty wells.

DR. KENNEDY: So in the, it's sounds like in the studies that looked at potential upwelling in sites other than Turkey Point, and again, we don't really have any data there, you know, there is no smoking gun.

There's nothing that says it's this, it's that, it's the other thing. It seems to be there is a possibility that it could be a conduit or a pathway, or it could be a leaky well.

MR. QUARLES: It could be a leaky well, and it, and so I guess, you know, going back to Cunningham, his, you know, it's plausible that these geologic features are these natural pathways of vertical migration.

DR. KENNEDY: And maybe back to the NRC staff, is there a smoking gun? Did I miss it?

MR. BARNHURST: So in reviewing these same documents, I just, I don't know that I could see evidence that the middle confining unit had natural features at the South District wastewater treatment that would allow upwelling.

I will note, as Mr. Quarles had said, that each of the studies that evaluated the potential causes of upwelling at the South District, would make a statement such that it could be a nature feature.

However, it's more likely a well-related issue. And I guess one study in particular that comes to mind is Alyssa Dausman with the USGS, I believe it was, I'm sorry.

I'll have it for you in just, it's her 2010, no. I've got it marked on my exhibit list. I apologize. I just want to give you the correct, well Alyssa Dausman, I, oh, NRC 47.

It's entitled Hypothesis Testing of Buoyant Plume Migration Using a Highly Parameterized Variable-Density Groundwater Model.

In that, she evaluated two different potential causes of upwelling at the, at the South District site, using a numerical model.

And while she mentioned that, there it is right there. On the first page, second column over, the bottom, oh, I'm sorry. It's, if I could just read it.

However, flow through a channelized pathway caused by well construction appears to be more likely.

That seemed to be the general tone in all of the, of all the studies that we, that we read and evaluated, was that it was, could not rule out the fact that it might've been a natural pathway.

There was no evidence for pathways at the South District. Through the entire middle confining, and that it was more than likely a channelized pathway caused by well construction.

DR. KENNEDY: All right, thank you. That's close to the smoking gun, but I'm going to ask Mr. Quarles, if that's not as smoking as I think it is. Go ahead, Mr. Quarles.

MR. QUARLES: So, I'll refer to the 2010 Dausman's report as well. Where she referred to the confining layer, the Delray Dolomite is only partially effective as a confining layer.

And the secondary porosity features such as fractures of the natural vertical conduit could be acting as a pathway for upward migration.

And then she also referred to isolated vertical conduit. It says through the heterogenous confining layers. So again, she said it could go either way, one or more causes.

DR. KENNEDY: Okay. So, there's both sides of the story in her article. I was kind of liking the however conclusion that has a more likely in it, but I think at the end of the day, it's both potential path, potential arguments are still in play. Still on well construction, one second.

MR. McNABB: May I add something with regard to our last question?

DR. KENNEDY: Are you buying me some time, Mr. McNabb?

MR. McNABB: Yes sir.

DR. KENNEDY: If you are, I'll take it.

MR. McNABB: Yes, Your Honor. One thing to note is that, as was pointed out, there seems to, that most of the studies seem to conclude or at least allude to, it is likely well construction issues.

It's also important to note that, you know, really since we've changed our construction techniques, we're just not seeing the problems that we were having.

And I think that helps support the cause of this being, these issues being related to well construction.

DR. KENNEDY: Right. Are you arguing that these noted instances were really of older wells, and that we haven't seen, there hasn't been any recent evidence of upwelling? These are time-related sort of, time shifted?

MR. McNABB: Yes.

DR. KENNEDY: Mr. Quarles, you've got to respond to that. Do you know of any more recent or possibly non-older-welled situations? I didn't talk about this until you brought it up.

MR. QUARLES: I've not researched the 17 or 18 sites to know when the wells were installed.

But I guess I would redirect your question, that's relevant is, do we know the age of all the wells that were installed in the 17, 18 in Florida that have a demonstrated upward migration?

DR. KENNEDY: Mr. McNabb, do you know the answer to that?

MR. McNABB: I do not, but --

DR. KENNEDY: Okay.

MR. McNABB: -- certainly we have records that demonstrate when those wells were constructed.

DR. KENNEDY: So it would've been, let me try it from a different way. You know, and later, the next issue we'll talk about well monitoring, or migration detection monitoring.

Did any of the injection wells have any signs that there was a failure in the, that they were faulty wells? I mean, was that noted anywhere?

Every, there's discussion about continuous pressure monitoring and, in the FEIS. Is any, was that in play in the older wells or does anybody know? I just wonder if there's any indication from the well itself that it may have been faulty.

MR. McNABB: The continuous monitoring of the annulus of an injection well, we only have that annulus for an industrial injection well. The municipal wells do not have that.

DR. KENNEDY: Okay. So --

MR. McNABB: But the, where we have, there have been very few instances where actually the well has demonstrated a loss of annular pressure.

And in these pieces, we had developed a leak at the, at the packer at the bottom of the well. Or in some older wells that were not constructed with fiberglass-reinforced plastic, you had a steel casing that corrosion took care of.

In all of those instances, what happens is the, what we're losing is fluid from the annulus, the corrosion inhibitor actually leaks into the well, out the bottom of the well into the boulder zone.

DR. KENNEDY: Okay. Thank you. I think Mr. Quarles, you started talking about this a little bit before when we were talking about well construction technology.

But in your pre-file testimony, Exhibit ING 022, at Pages 22 and 23, you state the contact between bedrock and the outer casing must be sealed for the entire depth of the well. Could you, you may have said this before, but could you explain to us what that means?

MR. QUARLES: So what I'm saying that the annular space needs to be sealed between the casing and the bedrock formation just to make sure that it's sealed.

DR. KENNEDY: Okay. For the entire length?

MR. QUARLES: For the entire length, through the confining layer, and ideally, for the entire depth of boring. Because you have multiple layers of groundwater that the casing is drilled through.

DR. KENNEDY: And you may have mentioned this before, but is there any way to ensure that there's good contact between the bedrock and the well for the entire depth? Is there any sort of testing or --

MR. QUARLES: So the methods that Mr. McNabb talked about on the grouting, the pumping, with trimming pipe, and then the pressure testing and the mechanical integrity test that they used.

DR. KENNEDY: And does the, maybe this is to Mr. McNabb. Does the continuous pressure monitoring have anything to do with the proper sealing of the casing, or is that a different issue?

MR. McNABB: It's very related. We're talking about the final. And yes, if we were to pop a hole in that final casing, pop a hole in our injection tubing, pop a hole in that annulus at the surface or at the bottom of the well, we would know instantly because the regulations require continuous monitor, pressure monitoring of that annulus.

That annulus is maintained at a higher pressure than your injection pressures. So that, we pop a hole, boom. We see immediately a decrease in pressure.

And what's going to happen is we're ensuring that our corrosion inhibitor is blowing out of the annulus and out the well into the boulder zone.

DR. MALIVA: May I please add one point? As part of the mechanical integrity testing procedure, you're required to do a cement bond log, which evaluates whether the cement is bonded to both the casing and the formation.

So that is, that is in fact evaluated as part of the mechanical integrity testing, as well as doing temperature logging during the cementing, which will tell you if there's any gaps or anything in the cement.

So that's a legitimate issue raised by Mr. Quarles, but that is looked at in great detail as part of the normal mechanical integrity testing process.

CHAIRMAN HAWKENS: A follow-up question for Mr. McNabb about the pressure monitor. Does an alarm go off if it reveals that there is a break in the integrity? Or is that a gauge that's monitored periodically?

MR. McNABB: You have, typically have a gauge on it, but it's also a pressure transducer. So that is typically sent through at the control room. My guess is typically they'll have an alarm.

But you, you know, it's there, visible. You are required to compile the data on a monthly basis.

So even if you were asleep at the switch and weren't paying attention to that pressure data, when you were compiling your monthly operating report, it forces you to look at that data.

So at that point, it should be very obvious, in which case you are required to make contact with DEP.

CHAIRMAN HAWKENS: If there was a catastrophic break, we're going to have to wait a month for somebody to take a very close look at those figures, or would that come to somebody's attention faster?

MR. McNABB: Well, if there were alarms

set, it would, they would automatically --

CHAIRMAN HAWKENS: Well, that's what I asked. Are there, are there alarms associated with that?

MR. McNABB: Not required. And I do not know the, our intention with regard to FPLs, how they're setting up their control room.

But you, in theory, you could spring a leak in your injection tubing or casing, and if you're not paying attention, it wouldn't become clear until you were preparing that monthly operating report.

Now, let's remember, if we do spring a leak, what's happening is we're losing annular fluid out the bottom of the well and into the boulder zone, and this is a non-hazardous annular fluid.

If we, if after that pressure is released from the annulus, then the pressure will equalize between the well and the annular space.

We sprung our leak, we've depressurized it, essentially, the annular space. And now those two would be similar.

Worst case scenario, we get some of the fluid that we're injecting down the well, actually goes into the annular space.

But again, that annular space is sealed

except for this leak we've just developed that has access only to the interior of the well.

CHAIRMAN HAWKENS: That's sealed by the concrete that you were, or the cement that you were talking about before that's between the casing and the --

MR. McNABB: Yes. If we spring a leak in the, in the, in the final casing, depends on where we spring it.

If we spring it down below where there's only the final casing, what we have to do is go through the half inch wall fit steel casing.

We've got to go through approximately five inches of cement. And then what we're doing is we're losing, again, non-hazardous annular fluid out wherever that leak is.

Now, if we spring our leak, say, at a depth of, we'll call it 400 feet, all right. Now we've got to go through our half inch, half inch thick steel casing, through another approximately five inches of cement, through our 3/8 inch thick wall, 34 inch diameter casing, through five more inches of cement.

Another 3/8 inch wall thickness of 44 inch casing, through five inches of cement. And now it finally can get to the environment. Many barriers.

CHAIRMAN HAWKENS: Let me ask a question of Mr. Quarles. I have a question, Mr. Quarles, for you. It seems like the state has come up with comprehensive requirements for the injection wells, and the industry itself has come up with best practices in an effort to prevent leakage occurring.

Is there a specific procedure that you view, either the state requirements or an industry practice, as being inadequate or deficient for purposes of this case?

MR. QUARLES: I don't see the procedures as being inadequate or deficient. The only thing that I would say is that you're drilling a well 3,000 feet deep and it's an imperfect science sometimes, and mistakes do happen, as indicated by the past leakages. Nobody drilled a well that they expected to leak.

So there's a lot of science that goes into this, and we try our best to drill a well that will never leak. But sometimes mistakes happen.

DR. KENNEDY: Do you think under the new technology with the continuous pressure monitoring that the leak would not be detected?

I mean, I get that it can have leaks. But would it go undetected or undetected for a period of time?

MR. QUARLES: I mean, clearly there's a period of time where, they were talking about, there's no alarm that goes off.

And so then you're doing a monthly report and then perhaps you don't know until a month. And so, you know, lots of these studies that talk about these leakage or upward migration, yet it can happen very rapidly.

So the question is, you know, how rapid is rapid and how soon is soon enough for a detection? And obviously if there would be a continuous alarm, I think that would go a long way and be in a best practice.

DR. KENNEDY: Thank you. The one, we've been talking a little bit here about mechanical integrity testing.

And I guess I note in the testimony that mechanical integrity testing is performed every five years. Mr. McNabb, is that a requirement of the state or is something that, you know, in plans to do?

MR. McNABB: Indeed it's a requirement of the state, every five years repeat the mechanical integrity testing.

DR. KENNEDY: And just what does

mechanical integrity testing involve?

MR. McNABB: Okay. During construction, our mechanical integrity's going to consist of, first of all, we're going to do a, run a pressure test on the final casing, the 24 inch diameter steel casing. We are going to run a temperature log on that final casing.

We are then going to install our FRP injection liner. Now we're going to run a pressure test on the annular space between the FRP and the final steel casing.

Although the two pressure tests I speak of, they are run at approximately 150 psi for one hour duration, and to pass, you must have less than a 5 percent pressure fluctuation during that period. Okay. Let's see.

We've also got a radio at the tracer survey that is performed on the final well. And I need to back up.

Before we install our FRP on, at their construction, we've got to run a cement bond log, to run the cement bond log on that final casing. So then we can install the FRP.

And I believe I've run through what we do for our initial MIT on, right after construction.

Five years later, we do the same except there's no CBL. No cement bond log because the FRP injection liner's in place.

So we do, we do the annular pressure test, the radioactive tracer survey, the temperature log, and I did leave something else out. Video survey.

We run a video survey of the well, looking for any things that may negatively impact the operation of the well.

DR. KENNEDY: To 3,000 feet?

MR. McNABB: Yes. We run it to the total depth of the well or until we either run into a, say an obstruction in the open bore hole, or sometimes at the bottom of a hole there's full of just extremely, I'll call it turbid water that had a lot of suspended elements in it.

Sort of in the bottom of the well, it's sort of stagnant, so things tend to just become stagnant there and you end up with a, oftentimes maybe 50 feet of dirty, turbid water.

Once we get into that, you're logging blind. You can't see anything with the video. So then we cut it short.

DR. KENNEDY: You used the acronym FRP?

MR. McNABB: Yes. Fiberglass-reinforced

plastic.

DR. KENNEDY: Thank you.

MR. McNABB: Sorry.

DR. KENNEDY: Mr. McNabb, could you briefly explain how the radioactive tracer test works?

MR. McNABB: Yes. I'd like to do that. The test begins with running a background gamma ray log from land, from total depth of the well to land surface.

The tool, the tool itself consists of three gamma ray detectors all spaced on the tool. We've got an upper, a middle, and a low ray detector.

We've also got a tracer ejector. The tracer ejector is located a few feet above our middle detector.

The, after they've run our background log with all three detectors operating, they take the tool out and they load it with Iodine-131, typically anywhere between 5 and 10 millicuries, the tool is loaded with.

The tool is then lowered down the well so that the ejector port on the RTS tool is located five feet inside the base of casing. We establish an injection velocity.

So we're pumping into the well at a low

rate of three to five feet per minute. So what we're doing is just creating a slow downward moving down the well.

And we release the tracer and we're moving very slow so we're giving it plenty of time to disperse after it's released.

And what we're doing with this tracer is looking for opportunities for it to migrate upward on the back side of the casing, which would indicate, oh, you've got a channel in your casing, or in your cement.

So, you provide opportunity for the tracer to move on the back side of the casing, up any existing channels.

You then use your detectors on your gamma ray detector. Especially the top one. The top one is a, is above where the ejection took place.

If you see elevated gamma ray counts on your top detector, it had to come up, had to go outside the casing and go up the back side.

It can't come, can't go back up inside the well because we're injecting it three to five feet per minute.

So looking at that top detector, we see elevated gamma ray counts, uh-oh, there may be a channel here.

If that does happen, what we do is we would move the tool up 20 feet and continue to run the test and see, is it, is it migrating up further?

We would try to track that to see if we actually see a channel that, if it ends at 30 feet, while it's a feature of note for sure and needs to be pointed out in our report, it's nothing that's going to alarm DEP if we still have nearly 1,000 feet of cemented casing.

DR. BURNETT: How long do you monitor the gamma ray?

MR. McNABB: The, we do two ejections, typically. The first ejection, we stay and monitor it stationary for one hour.

Now after we've, that one hour, we're going to log upward 200 feet, log upward looking for any stray anomalous gamma ray counts that may be an indication of a problem.

We're then going to actually try to flush that tracer away from the bore hole. So we're going to pump a minimum of 500 gallons down the well. Oftentimes more like 10,000 gallons.

And then we're going to do another log up 200 feet just to see if, by flushing, did that somehow chase any tracer behind the casing?

We then repeat the whole thing. We do another tracer ejection. Your ejection's typically 1 millicurie.

So we reposition five feet inside casing, eject 1 millicurie of iodine. This time we wait 30 minutes. Wait for any signs of fluid migration.

We do our 200 foot log. We then go down to the bottom of the hole, empty the tool of tracer and do a final background gamma ray log from the base of the well to land surface.

It's a very rigorous test. It's the best technology we have for identifying any sort of channels in, behind casing.

DR. BURNETT: Thank you.

DR. KENNEDY: Just one final question. Mr. Quarles, if I remember your testimony, you had indicated that this mechanical integrity testing is not sufficient.

If I remember that correctly, and you get to decide, I guess I'm curious, are you concerned about the frequency of testing or the type of testing, and if you could elaborate on that.

MR. QUARLES: So in my testimony, I discussed the mechanical integrity test cement bond log not being done to the full depth, length of the boring. And the fact it was done, then I was incorrect in that comment.

DR. KENNEDY: Does that alleviate your concern over the mechanical integrity testing then?

MR. QUARLES: It does.

DR. KENNEDY: Thank you, sir. And with that, I have no additional questions. If my colleagues have any follow-ups?

CHAIRMAN HAWKENS: Let me ask Counsel, the Board is ready to proceed to the next panel. We can take a 10 minute break if you all would like.

MS. CURRAN: We would appreciate a break. Thank you.

CHAIRMAN HAWKENS: All right. Let's take a 10 minute break. I have five after. We'll reconvene at a quarter after. Thank you.

(Whereupon, the above-entitled matter went off the record at 3:06 p.m. and resumed at 3:17 p.m.)

CHAIRMAN HAWKENS: Please be seated. We're now going to begin questioning our third panel. Third panel members are the same as the first and second panel, but would you please identify yourself for the record starting with Joint Intervenors?

MR. QUARLES: My name is Mark Quarles.

DR. MALIVA: My name is Robert Maliva.

MR. McNABB: My name is David McNabb.

MR. THORNE: My name is Paul Thorne.

MR. BARNHURST: My name is Dan Barnhurst.

CHAIRMAN HAWKENS: Thank you. And the witnesses are once again reminded that they remain under oath or affirmation.

This Board will be discussing whether upward migration of wastewater would likely be detected before it reached the Upper Floridan aquifer.

TOPIC 3 QUESTIONING

DR. KENNEDY: Okay. So far we've passed the mic test. Some of the, some of the questions here have been touched on, both under the well construction and in some of our previous discussion.

So I'll try to cull through the, but I may miss a few, so you may be punished with an additional question that you've already answered. So I appreciate your patience.

As Judge Hawkens said, this is about the detection of the upper migration of wastewater, and it being detected before it reaches the Upper Floridan aquifer. I'll direct my first question to Mr. McNabb. Glad to see you back on Issue number 3, sir.

MR. McNABB: Thank you.

DR. KENNEDY: If you could describe, and I know we touched on this before, but just to, for this part of the, part of the discussion, describe the general terms, the proposed monitoring system to detect injection well failures and potential wastewater migration.

MR. McNABB: Sure. And the way this begin was FDL is required to submit a proposed monitoring plan to DEP, and they then modify it as they see fit, and that ends up in our permit as a requirement.

So the permit requires that we monitor, let's, we'll, let's start with the injection well. Continuous flow rate monitoring, continuous annular pressure monitoring, continuous wellhead operating pressure monitoring.

The waste stream that goes down the injection well is also sampled on a weekly basis. The weekly sampling that we're, that I'm talking about, typically after about six months of operational testing, that gets reduced to monthly.

You send a request to DEP to reduce that. If they agree that the data will support a reduction in sampling the frequency, it can go to monthly.

So we start off weekly sampling of the, of the injection well. That ultimately is likely to move to monthly.

That sample, water sample, waste stream sample is going to be monitored or analyzed for roughly 10, 12 parameters.

Fairly basic parameters. PH temperature, sulfate, total dissolved solids, chloride, specific conductivity, sulfate.

There's going to be some other parameters that they are wanting, even initially they're going to have these following parameters would be on a monthly basis.

Calcium, bicarbonate, potassium, magnesium. I'm probably leaving one or two out, just off the top of my head.

But it's a fairly, should I say, a fairly simple parameter list. Okay. That's our injection well.

Our monitor well, we are going to be continuously monitoring the water level of both zones of the monitor well.

The idea there, if we see, say, a freshening trend, if we see relatively fresh water migrating into that zone, we're going to see an increase in pressure.

So that gives us very quick indication if we, if we see an increasing trend in pressure, we may have some freshwater moving in.

It's time to, time to look very closely at the well. Also we're sampling on a weekly basis, both zones. Same parameters in the waste stream.

The parameters are really selected to help you identify, to serve, in a sense, as markers. You notice that we had TDS chlorides conductivity.

We've got all sort of salinity-related. This is, you know, if we've got some fresher water moving into the, into the zone, we're going to see that freshening trend.

So that's what the whole idea of the monitoring the program is. Let's, first of all, let's see if there's an instantaneous problem.

If we see actually a well mechanical issue, all right. Let's monitor our monitor zones. Especially that, you know, we're monitoring both zones, but our lower zone's our early warning system.

We see pits there, we see something that is alarming, we've got time to react. We've still got about over 400 feet of material before we would hit the USDW. That gives time to move into action.

More than likely, if we see pits at that monitor well, we're probably removing that well from service. That's the monitoring program.

DR. KENNEDY: Okay. So the pressure monitoring is on the injection well, and this level monitoring system is on the monitoring well?

MR. McNABB: Yes. We've got pressure on the annulus of the injection well, and pressure on the wellhead operating pressure.

DR. KENNEDY: Okay.

MR. McNABB: And yes, the, we'll call it level. You could also call it pressure of your monitor water levels.

DR. KENNEDY: And I guess I'm, so that you were making a distinction between, it's a, you measure the same parameters that you do on the injected fluid?

MR. McNABB: That is correct.

DR. KENNEDY: And so if you see those parameters in your monitoring well, is that an indication that wastewater has breached the lower region of your monitoring well --

MR. McNABB: Not --

DR. KENNEDY: -- or not?

MR. McNABB: I'm sorry.

DR. KENNEDY: I guess, so you, because you're making a distinction between a freshwater, which I guess has some bearing on the impact of the condition of your monitoring well, versus the 10 parameter, the injection parameters that you're monitoring, and what you infer from that. And I guess that's the piece I was missing in the monitoring well.

MR. McNABB: Okay. For example, our lower monitor zone, I believe the total dissolved concentration in that lower monitor zone, if I remember correctly, is roughly 20,000 to 25,000 milligrams per liter.

The fluid that we're injecting is, I believe, closer to 4,000 or 5,000 milligrams per liter, total dissolved solids.

So if that, if we did have migration from our injection zone, that fluid with a 4,000 or 5,000 TDS, you know, we're going to see that mixing in with our 20,000. All of a sudden you'll see a freshening. Did I, did I answer your question?

DR. KENNEDY: I believe so. So it's really the trending of that, of those parameters in the lower, in the lower part of the monitoring well that is, what begins to get your attention?

MR. McNABB: You are correct.

DR. KENNEDY: Yes, okay.

DR. BURNETT: Mr. McNabb, Walsh used ammonium as a tracer for the injectate. Would the ammonium concentration in the fluid injected at Turkey Point still have high ammonium, or does that come out in treatment?

MR. McNABB: I expect it's going to have ammonia, although I must say I'm not qualified to, I really don't know exactly what our waste stream is going to look like.

I know, got an idea of the total dissolved solids, but I don't have a good characterization of that.

DR. BURNETT: Is there anyone else on this panel that can answer that question? Ammonium was not listed in your parameters, I don't believe. But you didn't feel that you remembered all of them.

MR. McNABB: Ammonia is not one of them. Ammonia is part of total Kjeldahl nitrogen. It's a component of total Kjeldahl nitrogen. So when it's --

DR. BURNETT: And that is, that is measured --

MR. McNABB: Yes.

DR. BURNETT: -- Kjeldahl nitrogen?

MR. McNABB: Correct.

DR. BURNETT: Thank you.

DR. KENNEDY: So what are the remediation actions if a leak is detected, I guess, I guess first in the injection well? I guess that would be the continuous pressure monitoring?

MR. McNABB: If a problem were detected in the injection well, more than likely what it's going to be is a leak in the packer at the bottom of the well.

When they do develop a leak, that's usually where it's at. As long as it's a recent well that has a FRP injection liner.

There are ways to fix that and that's what happens. You have to fix it. You can, I did one recently where what we did was we set a bridge plug or a plug down below the base of the casing, base of, yes, below the base of the casing.

We put some, spotted some cement there. Put a little bit of cement, I got, I'm sorry. I'll be careful of well drilling terms.

Placed a little bit of cement on top of that bridge plug. We pulled up the FRP liner, pulled it out of its packer, and then we pumped cement down the well called a pressure grout.

So that we were pumping cement, it was being released about three feet inside the base of the casing. The top of the well is sealed.

The only place for the cement to go is out the base of the casing and up the back side of our FRP.

We filled up about 75 feet of that open annular space at the bottom of the annular space. Filled that up with about 75 feet of cement, thus repairing the leak.

We then went in with what's called a mud motor. Something that you can put down the well that will drill out that cement plug that was left after the cement job.

So there are ways to repair such leaks. If it's a leak in that, in injection tubing, you pull it out and replace it.

We've not had any pop a leak in the final casing. Now, if that were to occur, my recommendation was patch it.

There are patches out there that you can lower to where that leak location is, and you can run a tool through it that'll make it expand and seal up against the inside of the casing.

So there are, there are repair options. Now, well, I think you were going to ask further, but you just asked about the injection wells.

DR. KENNEDY: Right. So let's just, so the, I guess the part of what I was after is the injection well, if it's repairable, it's repaired.

It's not, so it's taken out of service, the leak is diagnosed and potentially repairs are made, and then put back into service. Is that the way I should think of this?

So it's a repair, you know, stop injecting I guess, repair, and then being the injection process again?

MR. McNABB: You got it. Now, I will say this. When, a few cases where we've seen a leak develop, say at the, at the bottom of the well at the packer, it is, all right, guys.

You guys continue to operate your well, but we need a plan from you now. You know, this is, this particular well is located at a wastewater and water treatment plant. They need to operate.

But, and they also take into account, look what, look what's happening here. Our non-hazardous annular fluid is going out the bottom of the well and into our boulder zone.

So they see no environmental risk in allowing us to operate. But they, unless there's an environmental risk, they allow us to operate until we have a plan in place, and then they push us to implement that plan.

DR. KENNEDY: I guess I was wondering too, and maybe just part of what you're alluding to, the sensitivity of the pressure monitoring system, small leaks, big leaks.

I mean, how sensitive is it? Is it, is it able to detect a relatively small, and again, I don't, I have no feel for what kind of leak size we should be talking about here, but I guess I'm really wondering, is that your first line of defense, the pressure monitoring system, the injection well, or is the more important system the dual zone monitoring system?

MR. McNABB: In my opinion, the dual zone monitor well. You know, if we detect a leak in that well, it's extremely unlikely that it's leaking outside the, going out into the formation through the casings and the cement.

So if we develop a leak, it's going to be at the, either in that tubing or in the packer at the bottom of the well.

And what's happening? We're just getting fluids going down the boulder zone. So there's no environmental harm in that case.

So we detect a problem with the injection well. Really, no environmental risk, but you know, our detection method is now, should I say, compromised.

So we want to repair it real quick and get our monitoring up. Your monitor well, we see hits there.

That means, oh, you know, we have seen something come up through either, more than likely confinement, since it's not going to come out via side of the well in my opinion.

So then that would be of more concern for sure. At the, we hit the lower zone, there's a concern, but it's not a violation.

But now let's take action and make sure we don't have a violation. And that's, again, possibly removing the well from service. That sort of thing.

DR. KENNEDY: The potential for a violation, is that based on, is that with the dual zone monitoring, you would rely on that to have, make that assessment?

In that, because that really says you're having wastewater migrating in a direction you don't want it to go in.

MR. McNABB: Yes. That's going to be our, unless we, for example, in our mechanical integrity testing, we found a problem. There was an obvious issue.

But yes, it's, if we see that migration into that lower zone, it's time to pay attention and come up with a plan for making sure we do not impact the USDW, which would be a violation.

DR. KENNEDY: That's one of the things I struggle with. It seemed to me like the continuous pressure monitoring would be a real strong tool to understand the health of the injection well.

But I could also see you could have spurious alarms if it was alarmed, and you could have small leaks, you know, causing all kinds of alarms.

And yet you'd still have the capability to continue operating without any impact. And it sounds like that's, that, to me, is what you just communicated is that there's an assess and evaluate option available to the operators of these, this well system.

MR. McNABB: I don't believe that is the case. You know, we have to give the data to DEP, or so we can't just make our own evaluation.

Or if we do, I guess DEP's going to do their own as well. But it is very sensitive. The pressure, the annular pressure monitoring is very sensitive.

We've found leaks through, they send me

data. You see a decreasing trend in pressure. Where you, typically this is on a new well that, where you've got a leak in your nitrogen system that is keeping your annular pressure system pressurized at surface.

Part of our annular system is an annular pressure tank, typically, oh, a, we'll call it a 400 gallon tank, half full of Baracor, or corrosion inhibitor.

And this is connected to our annulus. And the way we're pressurizing our annulus is we're actually pressurizing the annular pressure tank.

Typically that's being pressurized, well, oftentimes being pressurized with nitrogen tanks, and that piping between the nitrogen tanks and the annular pressure tank, oftentimes you can develop leaks.

It's hard to get them initially. Sometimes a new well, in the first month or so, you're chasing these very, very minor but detectable, nitrogen leaks. You go in with the soapy water, find them, tighten things down, and you put an end to that trend.

DR. KENNEDY: So the, do I, I'm getting your sense, does state of Florida have a requirement on both the, or a specification on the sensitivity of this pressure monitoring system?

And if it alarms or goes off or indicates a leak, is it, do you have to report that to the state of Florida?

MR. McNABB: First part of the question, I'm not aware of any requirement with regard to sensitivity.

DR. KENNEDY: Okay.

MR. McNABB: Second, yes. The rule, the permit that they have, the rules require, and their permit states, within 24 hours of an indication of a lack of mechanical integrity must make contact with DEP to inform them of the issue.

DR. KENNEDY: So without the state requirement on sensitivity, how do you set, you know, the sensitivity of your system?

I mean, how did you decide, you know, how, what size leaks you want to detect or leak at all, I guess?

MR. McNABB: That's a toughy. We've gone with, you know, quite honestly, I've always used a similar system. It's proven to be sensitive, very sensitive. That's the best I have for that question.

It, quite honestly, my clients want to know if there's an issue with their well. They're not going to let me put something in there that's not going to detect an issue.

DR. KENNEDY: In mechanical integrity.

MR. McNABB: That's correct.

DR. KENNEDY: In terms of the final setup of the wells and dual monitoring system, I guess I meant to check it but I didn't, but is there a good diagram within the exhibits that shows the layout of the injection wells and the dual zone monitoring wells? And I'm also kind of interested in what the aerial footprint of that combination of equipment is.

MR. McNABB: May I ask my client that question?

DR. KENNEDY: Feel free. And Mr. Barnhurst has his hand up as well.

MR. BARNHURST: Yes, sir. I believe that what you may be looking for is Figure 3-7 in the final environmental impact statement.

It's the planned view of where the injection wells are going to be located. It's NRC-008A, is the number.

And it's a planned view of where the injection wells will be located, over to the observation wells, monitoring wells.

DR. KENNEDY: Maybe Andy, what page was

that, or what --

MR. BARNHURST: I'm sorry.

DR. KENNEDY: It was Figure 3-7?

MR. BARNHURST: It's Figure 3-7 and it's on Page 3-12.

MR. McNABB: Would you like me to give you just a very brief overview?

DR. KENNEDY: That would be great because I --

MR. McNABB: Oh.

DR. KENNEDY: -- I think I missed this picture.

MR. McNABB: Okay. Our injection wells, we've got 12 injection wells, six monitor wells. The injection wells are actually placed as pairs with a monitor well between each pair.

Do you see the set of three dots placed? Okay. Those represent our, we'll call them little pairs of injections wells with the monitor well in between.

Those, the injections wells are roughly, approximately 75 feet from the monitor well that's in between the two. And I believe we've got a 600 foot spacing between our pairs.

DR. KENNEDY: So between these, any set of three dots, there's a 600 foot separation? Is that what you just said?

MR. McNABB: I believe that to be the case.

DR. KENNEDY: Okay. And so, okay. This is good picture. And let, if we could leave it up there for just a second, I wanted to turn to Mr. Quarles because, when I start thinking about this groundwater, this monitoring system for the wastewater, in your, in your testimony on Page 23 on Exhibit INT-022, you indicate that it is likely to be able to detect upward migration in time.

And I guess there's a time factor here. And you point to two factors. The sampling is not frequent enough, and we talked a little bit about the frame, the sampling frequency, and the constituency may migrate horizontally before moving upward.

So guess, is the potential that something catastrophic could happen in between the sampling frequency and not be detected, and it's possible that the fluid from one of these injection wells would migrate horizontally before moving upward and being detected. Is that, is that your concern, among others?

MR. QUARLES: Among others. So you know,

back to what ETA said back in 2005 is that compliance monitoring programs are not sufficient to protect against movement of contaminants in the USDWs, nor do they provide sufficient early warning of contamination.

They also concluded that once contamination is detected, it may be too late to prevent endangerment.

So you know, that's very, very important to remember those two conclusions of the complex geology of southeast Florida.

The other thing that I'll add is that when you look at Walsh and Price and Cunningham, they frequently use the word bypass.

Bypass, meaning they bypass confined layers and show up in shallower wells, but not in deeper wells. All right?

So the adequacy of a system must be capable of detecting a bypass. When I look at, and so that's just in the general term of the EPA and whether or not early release detection worked.

DR. KENNEDY: Just, was that in regard to wastewater-type constituents like we're dealing with here or --

MR. QUARLES: It is.

DR. KENNEDY: -- just in general?

MR. QUARLES: Specific to wastewater injection that UIC cites. All right. So you talked about, okay, we have four constituents of concern. How often do we test of those and where do we test for them?

If you look at the South District wastewater treatment permit, they don't test for the four constituents of concern for their wastewater discharge permit.

Mr. McNabb just described the sample program, but the injection wastewater that he had, they intend to sample, and did not include the four constituents of concern in the list of parameters.

Instead, you know, have the, our dozen "basic"-type indicator parameters. All right? So if you're not testing for the four constituents, and then you recognize that you have limitations in the adequacy of the monitoring system, according to EPA, to even detect an early release detection, and even in fact bypass deeper wells and confining layers and in the deep down and shallow layers.

And that raises all kinds of issues. And I guess when I look at this diagram, I see the Biscayne Bay on the right, which would be your left.

And the monitoring wells are clustered around the eastern side and the southern side of the site.

One of you asked earlier this morning about, what is the direction of groundwater flow after injection begins?

And I think there was some discrepancy, some people said that the direction of groundwater flow is going to be to the west.

Somebody else said it's going to be to the east. In that diagram, if it flows to the west, there aren't monitoring wells.

MR. McNABB: I thought, I thought the, there's two different concepts being discussed this morning. One was sort of the general flow direction, which was to the west, and the other had to do with when there was an injection, and that that could've had an eastward component to it. So I'm not sure. They may be different, to me there were different types of movements.

MR. QUARLES: I guess this diagram here assumes that upon injection, all of the groundwater, the direction of the new groundwater flow with injection will be to the east toward Biscayne Bay and not the west.

So obviously the location isn't important, both by depth and what part of the site that you're monitoring.

But even with that, ETA is saying, compliance monitoring systems don't work. So then while we're talking about monitoring, the COC, constituents of concern are not monitored at the wastewater plant.

They're not proposed to be monitored prior to injection here. So then the question is, are potable water supply systems routinely testing for these four constituents of concern?

And the answer is, initially potable water systems might have to test on a quarterly basis, but then if they have no detections they can request that they no longer sample for the OCs.

So let's just say long term, if there's a few quarters of non-detect, they may never sample for these four constituents again. So if they were there in the potable water supply, you may never know it.

DR. KENNEDY: And I get the sense that you, it seems like this is part of a state of Florida program to monitor this injectate, and it sounds like the EPA presents a picture that is folly.

And I'm not sure how to, how would, to be, you know, how do reconcile that dilemma for me? So the state has been doing this for some time, and they've developed a program with all kinds of requirements. And the FP&L here seems to be trying to follow those requirements.

MR. QUARLES: So particularly related to the adequacy of a monitory system to be effective as an early release detection is further complicated by the presence of natural vertical conduits.

It may or may not exist at the site that the seismic evaluation would be a reasonable scientific evaluation to determine the likelihood of the presence of those.

That's where it gets complicated is that, is that where those conduits are present, EPA is saying there's very little confidence in the ability of a monitoring program to protect prior to endangerment.

DR. KENNEDY: Did that also include systems like this that has a, say a continuous pressure monitor on the injection well? Or is it only speaking to the, that sort of dual zone monitoring system that we have here?

MR. QUARLES: Speaking to what the EPA discussed in the 2005 UIC Rule.

DR. KENNEDY: Okay. Dr. Maliva, would you like to --

DR. MALIVA: Yes. There's a whole hand full of points here that need to be clarified. First of all, as far as groundwater flow direction, the general belief, as far as regional groundwater flow direction, ambient, is within the boulder zone, is a very slow movement inland to the west.

Within, above the boulder zone, with the Upper Floridan aquifer system, the groundwater flow direction is clearly to the southeast.

We have in Florida, the Polk City potential metric. High groundwater flows regularly away from there. So at this site, within the Upper Floridan aquifer, it's going to flow offsite.

The Intervenors are correct that the monitoring program doesn't include those four programs.

For the monitor programs, you use indicator parameters that would clearly indicate the presence of injected water.

You wouldn't use parameters that are already present just at the edge of detection limits as you're monitoring your parameters for wastewater. I mean, that would make no sense.

You'd use things like chloride, salinity, nitrogen in which there's a very large difference between interjected water and the native ground water, so that even if you saw a little bit of mixing, you would detect it and you would know from those indicated parameters.

You, I mean, it's non-workable to say you're going to, you should monitor for every parameter that could conceivably be present in wastewater on a weekly basis. That's not practical.

So it's a very well-thought out set of parameters and indicators that would let you know if vertical migration were to occur.

And again, the comments on what the USEPA concluded, and wonders if that is correct, that you're never going to have perfect monitoring as a means of providing that 100 percent mathematical certainty, that endangerment of the USDWs is not going to occur.

What they did recommend instead was an added level of treatment so that you treat your water so that if it migrated up to it's at the USDW, it would not result in a regulatory violation.

So the strategy that was adopted was just to maintain the current monitoring program of a dual zone monitor well, your injection well, which is the location most likely to detect it.

And then, again, treat water to a higher degree so that if you, in the very unlikely event that it did migrate into USDW, it wouldn't result in endangerment.

And if we're already starting out with water that meets drinking, federal drinking water standards, there's no endangerment issue.

Endangerment is defined as causing a violation of a primary drinking water standard. If your injected water already is there, you know, there's not a regulatory issue.

CHAIRMAN HAWKENS: Mr. McNabb, I'm looking for EW1 on here. I may be overlooking it.

MR. McNABB: You are not.

CHAIRMAN HAWKENS: Where would it be in relation to these wells?

MR. McNABB: It would be to the southeast corner, just off corner. Southwest, I apologize. Southwest.

CHAIRMAN HAWKENS: With the placement of the monitoring wells, are they required by the state regulations, or have they been determined by best industry practice?

MR. McNABB: Placement of the monitor

wells are required to be within 150 feet of the injection well. That's because it's the most likely place where migration would occur.

First of all, we have our greatest pressure buildup right near our injection well. So we, they want us to keep our monitor wells nearby.

Also they're the buoyant forces is greatest there. As we move away from the well, we get mixing, decrease on Buoyant force. So DEP wants us to put it, locate it in the place where we're most likely to have an issue.

DR. KENNEDY: Is there any philosophy here on how these, this pattern of wells is arrayed in the south and the east? Or is that purely coincident?

MR. McNABB: That's really to accommodate construction of the plant. Keep, you know, keep the, these on the perimeter and away from the main activity of construction.

DR. KENNEDY: All right, thank you.

CHAIRMAN HAWKENS: What are the, when everything is up and running, what is the maximum, what are the maximum number of wells that you contemplate would be used on any given day?

MR. McNABB: During the normal operation with reclaimed water --

DR. KENNEDY: Yes.

MR. McNABB: -- I believe that to be three. It may be four. And I suspect that one of the other panels will be able to clarify that.

Mr. Jacobs would be able to provide a better answer. But I've looked, three or four.

During operation of, with seawater, I believe it's nine. But again, he'll tell me, tell you guys if I'm wrong.

DR. KENNEDY: And what dictated the sampling frequency? I think it, was it monthly that you had indicated?

MR. McNABB: Start of weekly, but as long as the monitoring data is showing that the system is operating properly and in compliance, after six months we prepare a request to reduce frequency.

If DEP agrees with us that, hey, everything looks good, they typically will allow that reduction to monthly.

DR. KENNEDY: What about this question of horizontal migration? What would it take to bypass the monitoring well?

I mean, is it, is this a realistic scenario? I mean, it seems like that region down there is sort of open and things could move.

MR. McNABB: Things could move laterally some distance from the injection well. And extremely unlikely case that it moved upward into a zone that monitored by, say, the lower monitor zone.

If it were far enough away, I don't think it would detect it. But let's keep in mind, we're placing that monitor well in the place where it's most likely to have fluid migration.

But yes, I'll tell you, if we moved a mile away and it migrated upward, it would be very dilute by then.

We'd have very, very little Buoyant force. The mixing would remove the buoyancy. But I cannot tell you there's zero chance that would happen.

DR. KENNEDY: So there is a real possibility that it could bypass the monitoring well, even though it's in compliance with the Department of Environmental Protection requirements to be within so many feet?

MR. McNABB: While highly, highly unlikely, yes, it's possible that this fluid that we're injecting that meets federal drinking water standards could indeed migrate away from the well upward and not be detected.

MR. QUARLES: Can I, can I respond?

DR. KENNEDY: Mr. Quarles --

MR. QUARLES: Thank you.

DR. KENNEDY: -- please do.

MR. QUARLES: So I've heard it, I've heard it several times today, now that we're talking about migration prior to reaching the USDW, a discussion about, things are protected because the constituents don't exceed the federal drinking water standard.

But what I had not heard discussion about is the fact that the tetrachloroethylene exceeds the Florida drinking water standard.

DR. KENNEDY: We will be discussing that in the next panel discussion.

MR. QUARLES: Okay. Find.

DR. KENNEDY: If you want to hold that thought.

MR. QUARLES: So just to clarify that, I guess the other thing that I want to add is to use, you know, the quotation, it makes no sense to test for the four constituents of concern, and I would argue that it does because, what, three are probable potential human carcinogens at very low concentrations.

So the cost of testing for these four constituents is not, in the big scheme of things, is not much at all.

So I would counter to say that it does make sense to consider the testing of those four constituents.

The other thing that I would say is that the ambient direction of groundwater flow of the USDW, according to Dr. Maliva, is to the southeast, which justifies the placement of those wells.

But if, in fact, the confining layer leaks and you have upwelling of wastewater, like Dausman talked about in the 2008 study.

The water levels in the USA increased 20 feet over 30 years. If you increase, if it does leak and you have this upwelling into the UFA, you could reverse the direction of groundwater flow in the opposite direction.

So it's, you know, putting all your wells in the southeast side assumes ambient conditions will be there for the duration of the program.

And then the last thing I will say is that Dr. Walsh at the north district plant showed that the water migrated laterally, horizontally offsite, entered an offsite natural conduit, rose into the USDW, and then migrated onsite.

So lots of crazy things can happen with

the monitoring system. But I think it's unfair to assume that ambient groundwater flow conditions are going to occur all the time.

DR. KENNEDY: I guess I find it interesting. The point that Dr. Maliva made about the, if the high disinfectant treatment is given to the wastewater, then these chemicals are really below detectable limits.

And I, to me it's a very compelling argument not to use those as a leading indicator of if you've got a, got a leak in your system.

I'm a bit surprised that you don't find that a compelling argument. I'll give you a chance to restate it. Maybe I misunderstood.

But that seems like a very compelling argument to have use something else as a leading indicator of when you have a problem.

MR. QUARLES: So to respond to that, I would have to talk about my opinion on the accuracy and viability long term of the four samples that were collected after the use of the HLD, the high level disinfection, which I thought was kind of off limits.

DR. KENNEDY: I'm going to get, I'm sure we're going to talk about that in the other, the other panels, of which I know you're a member.

CHAIRMAN HAWKENS: Before going onto the next panel, I want to see if, especially the staff, has any final response to Mr. Quarles final statements.

MR. BARNHURST: Yes, thank you. I just wanted to speak to, just quickly, something that, Judge Kennedy, that you brought up.

You noted that there seemed to be some maybe disagreement between the FDEP underground injection control program requirements of new migration, and then the EPA who, as Mr. Quarles said, expressed uncertainty that the observation wells would detect any kind of potential upwelling.

If I could just talk to that document, that's a document that we considered. I read through quite a bit as we were preparing the final environmental impact statement.

And he's correct that they, that the EPA did say that they, because of the geology of Florida and the potential for upwelling, that they, I'm trying to find the quote here.

But basically that you couldn't, in the EPA's opinion, they expressed some uncertainty in the ability of the monitoring wells to detect the upwelling.

And so as a result, and I think it's already been alluded to by Dr. Maliva, the EPA shows how this infection as a, as a way to, they said that if you treat to that level, that even if it migrates, it's below a level which would threaten the, any groundwater sources at the site.

And so I just, I just wanted to I guess point out the fact that we noticed that as well. FDEP, Florida Department of Environmental Protection, takes a different approach.

They say that confinement, or upwelling cannot occur. EPA takes a different approach. Both of those approaches taken together I think are very protective in that you're cleaning up the source of the water.

You're also taking steps to limit any potential for upwelling and monitor for it. I think that was the point I wanted to make. Thank you.

CHAIRMAN HAWKENS: Dr. Maliva, any final --

DR. MALIVA: I would just, we will get to this later, but when we talk about cancer risk, we cannot forget the point that --

CHAIRMAN HAWKENS: We'll talk about that in the --

DR. MALIVA: Yes, the upper Floridan water has to go through an RO plant before it can be potably consumed.

So you know, even arguing over Florida versus federal NCLs, it's going to go through a desalination plant before anybody drinks it. It's going to be tremendously diluted. So I mean, that's where, you know, the small, I call infinitesimal risk comes into being.

CHAIRMAN HAWKENS: All right. Frankly, we'll discuss that in Panel 5. Will you be back to join us?

DR. MALIVA: Yes.

CHAIRMAN HAWKENS: So, with that, let's take a five minute break so we can have the fourth panel come up. We will start Topic number 4.

We may not be able to finish today, but we'll see how far we can get. Five minute recess. We will reconvene at six after.

(Whereupon, the above-entitled matter went off the record at 4:01 p.m. and resumed at 4:08 p.m.)

CHAIRMAN HAWKENS: Good afternoon. We're now prepared to question the fourth topical panel. As a reminder, in this panel we will discuss the impact of the four contaminants on human health if wastewater were to reach the Upper Floridan aquifer at the concentration values reported in Table 3-5 of the FEIS.

This panel has some new witnesses on it and several witnesses have left. So would the panel members please introduce themselves, MPL, or excuse me, Joint Intervenors?

MR. QUARLES: Once again, Mark Quarles.

DR. TEAF: My name is Christopher Teaf.

DR. MIRACLE: Ann Miracle.

TOPIC 4 QUESTIONING

CHAIRMAN HAWKENS: Thank you. Dr. Teaf and Dr. Miracle, let me start off by reviewing a few definitions.

My understanding is the EPA maximum contaminant level goal is a level of the chemical in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate safety of margin. Dr. Teaf, is that the understanding?

DR. TEAF: Yes, sir. And as we talked about earlier today, it differs for individual chemicals.

CHAIRMAN HAWKENS: Correct. And you would agree, Dr. Miracle?

DR. MIRACLE: Yes, I would agree.

CHAIRMAN HAWKENS: Okay. Mr. Quarles, I, you would agree with that as well?

MR. QUARLES: Yes, sir, I would.

CHAIRMAN HAWKENS: Okay, thank you. Andy would you display the FPL Exhibit 064 and of Page 5? All right. Dr. Teaf, let's deal first with ethylbenzene and toluene.

According to this, which is the Table 3-5 in the FEIS, the reliable and conservative value of ethylbenzene that will be injected into the boulder zone is below the method detection limit. Now, can you explain what the method detection limit is, please?

DR. TEAF: Yes, sir. The method detection limit is the value that is established as being reportable by laboratory with confidence of 99 percent that it is present.

It may not be present low, which is quantifiable numerically, but it is present, but it is not reliable below that level.

CHAIRMAN HAWKENS: All right. Dr. Miracle, you would agree with that definition of method detection limit?

DR. MIRACLE: Yes, I do.

CHAIRMAN HAWKENS: All right. And Mr. Quarles, you have, you concur?

MR. QUARLES: I don't know about the percent being accurate, but the method detection limit is a limit that can be reliable reproduced.

CHAIRMAN HAWKENS: All right. And I do think it's important on this Board to recognize the expertise of Dr. Teaf and Dr. Miracle in toxicology. What is your Doctorate in, Dr. Teaf?

DR. TEAF: It's in toxicology. Yes, sir.

CHAIRMAN HAWKENS: All right, thank you. And Dr. Miracle?

DR. MIRACLE: More broadly, molecular biology, but with experience in environmental toxicology.

CHAIRMAN HAWKENS: All right. Mr. Quarles, you have expertise in a broad number of areas, as demonstrated by the panels you're testifying on today. But is it correct to say that your expertise does not extend to the science of toxicology?

MR. QUARLES: I think it's fair to say that I don't have a degree in toxicology, but it, but it is fair to say that, you know, being in this business for 30 years, that you routinely use drinking water standards, risk of exposure levels, health based standards as a mechanism of determining the level of risk to humans, animals, that sort of thing.

So just by the nature of doing this sort of thing for a living, you're exposed to some degree of use of numeric standards for human and ecological effect.

CHAIRMAN HAWKENS: All right. Thank you. Dr. Teaf, the concentration of ethylbenzene is below a minimum detection limit, and for toluene it's 0.00174. Now, the EPA maximum contaminant level goal for ethylbenzene is 0.7. Is that correct?

DR. TEAF: Milligrams per liter. Yes, sir.

CHAIRMAN HAWKENS: So by definition, the concentration of ethylbenzene that's being injected into the boulder zone is at a level at which no known or anticipated adverse effect on the health of person would occur, and which allows an adequate margin. Is that correct?

DR. TEAF: Yes, sir.

CHAIRMAN HAWKENS: Dr. Miracle?

DR. MIRACLE: Yes, sir.

CHAIRMAN HAWKENS: Mr. Quarles, would you agree with that? By definition, can you just answer that yes or no? The definition of the EPA maximum contaminant level goal.

MR. QUARLES: I have to confess, I was distracted. I was getting a drink of water. What was the question? Sorry.

CHAIRMAN HAWKENS: The goal, the maximum level contaminant goal for ethylbenzene is 0.7.

MR. QUARLES: I will agree with that. Thank you.

CHAIRMAN HAWKENS: And ethylbenzene is below the MVA. And therefore, by definition, you could inject this into drinking water, and no known or anticipated adverse effect would occur on health and it would allow an adequate margin as well.

MR. QUARLES: Correct.

CHAIRMAN HAWKENS: All right. Thank you. Let's address toluene. Concentration injected into the boulder zone is 0.00174?

DR. TEAF: Yes, sir.

CHAIRMAN HAWKENS: And the EPA maximum contaminant level goal is 1.0. Is that correct?

DR. TEAF: Yes, sir.

CHAIRMAN HAWKENS: So what's being injected is several magnitudes less than what the goal is. Is that correct?

DR. TEAF: Yes, sir. It's true for both

ethylbenzene and for toluene that it's about 700 times less than drinking water standard. Therefore --

CHAIRMAN HAWKENS: And therefore, by definition, the injection of toluene into the boulder zone is a level in which as if it were injected in drinking water itself, no known or anticipated adverse effect on health of persons would occur, and which also allows an adequate margin of safety. Is that correct?

DR. TEAF: That's true.

DR. MIRACLE: Yes, that is correct.

MR. QUARLES: Yes, sir. Correct.

CHAIRMAN HAWKENS: Mr. Quarles, then, if that's the case, would you agree that for at least ethylbenzene and toluene, if they were injected into the boulder zone at the concentrations listed in Table 3.5, their environmental effects would be no greater than small?

MR. QUARLES: I would say that those constituent concentrations don't exceed the federal drinking water standard or the MCLG.

CHAIRMAN HAWKENS: Thank you. Can you answer my question now, with the environmental impacts as stated in the federal environmental, the final environmental impact statement --

MR. QUARLES: Yes.

CHAIRMAN HAWKENS: -- would their impacts be no great than small?

MR. QUARLES: According to the USEPA, it would, it would have no adverse health effects.

CHAIRMAN HAWKENS: All right. Thank you. Dr. Teaf, let's move to heptachlor and to tetrachloroethylene.

DR. TEAF: Yes, sir.

CHAIRMAN HAWKENS: The concentration for heptachlor is 0.00023 for injection into the boulder zone.

DR. TEAF: I think there's actually four zeros.

CHAIRMAN HAWKENS: There are four zeros. I only said three, I meant to say four.

DR. TEAF: Yes.

CHAIRMAN HAWKENS: 0.000023. The EPA goal for that is zero. On the other hand, the EPA maximum contaminant level for that is significantly higher, 0.0004. Is that correct?

DR. TEAF: Yes, sir. It's about 17 times higher.

CHAIRMAN HAWKENS: And it's your testimony based on the pre-filed material you filed with this

Board, that we, the determination of whether it will have an adverse impact on human health and safety should be determined by the EPA MCL, as opposed to the MCLG. Is that correct?

DR. TEAF: Yes, sir. That's correct.

CHAIRMAN HAWKENS: And can you explain why that is?

DR. TEAF: Yes, sir. The MCL is the standard established under the Safe Drinking Water Act.

It is the number that is used to determine the safety of distributed water throughout the United States.

Therefore, that number could be present in drinking water essentially anywhere, whether it's groundwater in this particular instance, or whether it's distributed water in a municipal water supply.

CHAIRMAN HAWKENS: Mr. Quarles, I'd like to hear from you on that, please.

MR. QUARLES: The MCL includes a number of factors in the determination in addition to the health-based standards.

It includes feasibility treatment, economics, that sort of thing. So it's not a purely health-based standard.

CHAIRMAN HAWKENS: Yes, I didn't hear the last statement. I'm sorry.

MR. QUARLES: It is not, the MCL is not solely a health-based standard.

CHAIRMAN HAWKENS: That's correct. But according to the EPA is it nevertheless safe for human consumption at those levels?

MR. QUARLES: The EPA has determined that it is acceptable as a primary drinking water standard, including the economics and the technology associated with being able to treat it.

CHAIRMAN HAWKENS: All right. Thank you. Dr. Teaf and if Dr. Miracle, it's true that both heptachlor and tetrachloroethylene concentrations in Table 3.5 are below the EPA MCLs. Is that correct?

DR. MIRACLE: Yes, that's correct.

DR. TEAF: Yes, sir.

CHAIRMAN HAWKENS: And Dr. Miracle, I want to confirm, is it true that qualified professionals in the field of toxicology, let me, and let me direct that to Dr. Teaf.

Is it true that qualified professionals in the field of toxicology would typically use MCLs and not the MCLGs to assess environmental impacts from these constituents?

DR. TEAF: Yes, sir.

CHAIRMAN HAWKENS: And do you agree with Dr. Teaf?

DR. MIRACLE: Yes.

CHAIRMAN HAWKENS: Do you have any reason to disagree with them?

MR. QUARLES: MCLs are primary drinking water standards that are typically and primarily used, but they, the MCLG also can be considered.

CHAIRMAN HAWKENS: All right. Let me ask a question of you, then, Mr. Quarles. The next series of questions will be directed to you.

Since the maximum concentration of heptachlor here, which is 0.000023, is less than its MCL, what greater than small health effects do you think would be associated in this case with discharging heptachlor into the boulder zone?

MR. QUARLES: Well, heptachlor, it does exceed the MCLG. And heptachlor is, I forget if it's a possible or a probable human carcinogen at concentrations that, the EPA said the MCLG, zero is the safe amount that should be, could be consumed.

CHAIRMAN HAWKENS: Thank you. Can you point to any study in this record where heptachlor in a concentration, it's listed in Table 3-5 or less is found to have a great than small adverse human health effect?

MR. QUARLES: So I did not do any research beyond the ATSDR ToxFAQs evaluation of heptachlor.

CHAIRMAN HAWKENS: All right. Let's turn to that then. Then I want to follow up with this question then.

You're not able then to point to any study where this concentration was associated with any adverse health effects. Is that correct?

MR. QUARLES: That is correct.

CHAIRMAN HAWKENS: All right.

MR. QUARLES: But assuming that the EPA, to determine that the MCLG would be zero had done a thorough evaluation to determine that such risk would occur.

CHAIRMAN HAWKENS: Let's turn again, rely on the ATSDR ToxFAQ, FAQ document. That's INT-016. And you testified that heptachlor, "can negatively affect the immune and nerve systems"?

Does that not even say heptachlor can negatively affect the immune and nerve system in the concentration at issue here?

MR. QUARLES: It does not give a specific concentration.

CHAIRMAN HAWKENS: Doesn't that document say that little is known about heptachlor's health effects in humans, but that at "high levels", heptachlor, "may cause damage to your liver and nervous system"?

MR. QUARLES: It does.

CHAIRMAN HAWKENS: Is it --

MALE: It's displaying ethylbenzene. It must be --

CHAIRMAN HAWKENS: Right. Andy, if you could go to page, keep scrolling down on that document and you'll come to an, or heptachlor. There you go. Thank you.

Is it your position that heptachlor that's listed at the level in Table 3-5 represents a high level of heptachlor consistent with this document?

MR. QUARLES: That document doesn't define what a high level is. I guess the thing that really stands out to me is anything that is a potential probable human carcinogen would be very concerning to me.

CHAIRMAN HAWKENS: Dr. Teaf, I think I remember reading in your testimony that the EPA MCL took into effect the potential carcinogenic affect. Is that correct? And if yes, can you please explain that?

DR. TEAF: It does, Your Honor. And yes I can explain it. In addition to EPA's consideration on technical feasibility of the way in which they do that is that they look at what's called the practical quantitation limit.

It's not quite the MDL, but it's a similar concept. That is the functional definition of zero, as far as the analytical chemists can define it for us.

So while that number certainly could go down over time, that number is clearly a safe value because it falls in EPA's potential cancer risk range, 10(-4), 10(-6), 1 in 10,000 to 1 in 1 million.

So heptachlor has been considered not only on an analytical basis, but also on a risk-based health basis.

CHAIRMAN HAWKENS: Dr. Miracle, do you have anything to add to Dr. Teaf's testimony?

DR. MIRACLE: Only to point out that in the same document, INT-016, on Page 6, describing further recommendations to protect human health, it also lists another, two other agencies.

The FDA, the Food and Drug Administration, and OSHA, Occupational Safety and Health

Administration, and their limits regarding exposure to workers from occupational types of activities, and also for food sources on raw food crops and also edible seafood. And the concentrations in both of those cases is larger than the MCL for safe drinking water.

CHAIRMAN HAWKENS: All right. Thank you.

DR. TEAF: I meant to say that. I meant to say that.

CHAIRMAN HAWKENS: Mr. Quarles, do you have any response to that?

MR. QUARLES: I would just add that food crops and edible seafoods, you know, we're talking about a groundwater exposure in the discussion.

CHAIRMAN HAWKENS: Fair enough. In Dr. Teaf's direct testimony, he cites a study where he testifies that, "the lowest observed adverse effect level" for heptachlor occurred in animals at a dose that's more than 49,000 times greater than the dose for heptachlor that could occur at the concentration in Table 3.5. Do you have any reason to disagree with Dr. Teaf's statement in that regard, Mr. Quarles?

MR. QUARLES: I do not.

CHAIRMAN HAWKENS: Let's turn now to tetrachloroethylene. Andy, back to the FPL-064 exhibit please, Page 5.

Yes, thank you. The concentration table of 3.5 for tetrachloroethylene is 0.00359, and the MCL for that is 0.005.

But the Florida Department of Environmental Protection MCL, now, do they call it MCL in Florida as well, or do they have a different term for it?

DR. TEAF: They use that term.

CHAIRMAN HAWKENS: Their level is 0.003. And there's controversy in the testimony about why if that's, in fact, an enforceable limit, it shouldn't be enforced here. Can you addressed that, Dr. Teaf? And then we'll hear from Dr. Miracle.

DR. TEAF: Yes, sir. I can. Tetrachloroethylene is, it's also perchloroethylene or perc, you may, I may slip and call it that, is a substance that has a great deal of regulatory interest.

It's present in groundwater and soils in a great number of contaminated sites, and so therefore it's been the subject of attention by EPA, by DEP, by most state agencies, by the Agency for Toxic Substances and Disease Registry.

So it has heard its toxicology reviewed

over and over and over again. In 2012, the USEPA released a new metric that is used to evaluate cancer risk called the cancer slope factor.

That cancer slope factor released in 2012 was about 25 times greater, less restrictive than, less restrictive than the value that was available in the mid-1980s when the original MCLs were established within Florida and at the federal level.

If one uses that new slope factor, both the cancer risk at the MCL at the federal level and the MCL at the state level are both well below 10(-6), 1 in a million cancer risk, which is the, considered to be the de minimis cancer risk.

So to the extent that EPA or DEP are ever going to review and recalculate their MCLs, changing only that single value, which is now co-defined in EPA's regulations, you would yield numbers considerable greater than 3, 0.003 or 0.0005.

My point is not to say that they should or might or would change their MCLs. Agencies tend to do that only with great thought.

My point is that the new EPA drinking water, tap water criteria that's been released probably within the last year or 18 months, is 11 micrograms failure, 0.011 milligrams per liter.

CHAIRMAN HAWKENS: And that's the recommended? That's not, they're recommending that to be the MCL or what are they recommending?

DR. TEAF: It is the tap water level for comparison with groundwater and drinking water concentrations. It doesn't change the MCL. You're absolutely correct.

But my experience with regulatory agencies is, if the new number is higher than the old number, then you keep the old number in case.

But it doesn't mean that a number slightly greater than 3 is dangerous. And that's particularly true in the case of perchloroethylene or tetrachloroethylene because of this new official change about five years ago on the part of EPA.

So I have no concern with, whatsoever, with respect to potential human health risk here at all.

CHAIRMAN HAWKENS: Dr. Miracle?

DR. MIRACLE: In the FEIS and Table 3-5, we considered only the federal MCLs when we came to our conclusions regarding these levels or the concentrations in Table 3-5 as being protective of human health.

However, I'd also like to point out that the south district wastewater treatment plant did add an additional technology including high level disinfection.

At a year's worth of sampling, at least four different sampling times were then included in Table 3-5 as a footnote, but it's still included in Table 3-5. And for all four of the constituents, were not detected.

CHAIRMAN HAWKENS: Do either of you know whether the state of Florida has signed off on this well as this injection level of tetrachloroethylene, what can be inferred from that?

And another way of asking that question is, does the state of Florida perhaps recognize that its state MCL is more conservative than it need be?

This is, again, based on your experience. And I'm just wondering if there's answer and whether you can provide an answer.

DR. TEAF: I think my, well, no, I don't think. My answer is that the state of Florida would go through, perhaps not quite the process we're going through here, but a similar one in which they would look at all the kinds of considerations you're looking at.

Fate in transport, injection

concentration, injection volumes, well construction, hydro-geology and all those things.

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 that 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 they would be looking for.

CHAIRMAN HAWKENS: All right. Thank you. Anything to add?

DR. MIRACLE: I want, I was going to add, I think our next panel, Panel 5 will probably be discussing that in a little bit more detail.

CHAIRMAN HAWKENS: Yes they will. Mr. Quarles, do you have any response to what's been said to the Board?

MR. QUARLES: I do. So, let me give you a little bit of background. Dr. Teaf mentioned the expression, it has no concerns about injecting wastewater that might exceed the Florida MCL, tetrachloroethylene.

Let me give you a little background of why I have a conservative view of being protective. Back in 2001, I was asked by a consulting firm, which is EPA Region IV star coordinator in the state of Tennessee to review a rumored cluster of birth defects in a small town west of Nashville that was rumored be related to ingestion of trichloroethylene, which is a solvent very similar in nature to perchloroethylene.

So it was believed that, according to CDC and some other researchers, that a one-time ingestion of trichloroethylene during the first trimester of pregnancy could cause a cleft palate, cleft lip.

And there's a cluster that occurred and was suspected to have been related to a one-time ingestion.

And so you have a landfill that had known industrial waste in it. You had a municipal well that was located adjacent, a municipal potable drinking water well that was located adjacent to the landfill.

Then you have a wastewater, a water treatment plant that was taking water from surface waters in addition to ground water for distribution to a potable water system that went to an entire, most of the entire county.

So everybody's following the rules, and that particular drinking water plant was required to test for volatile organic compounds to meet their permit once a year.

And so they had been following the calendar year to do that because they had never detected TCE in their potable water supply.

And around Christmastime, they sampled it as a formality, and recognizing it's a finished water that's already in the distribution system.

And so lo and behold, they had a detection of trichloroethylene, just slightly below the federal MCL, and that really surprised --

CHAIRMAN HAWKENS: I'm sorry. What contaminant?

MR. QUARLES: It was trichloroethylene.

CHAIRMAN HAWKENS: Okay.

MR. QUARLES: Which is very similar to tetrachloroethylene. And in fact, tetrachloroethylene degrades to, under certain degradation conditions, into trichloroethylene, which degrades into vinyl chloride, which is, has an even lower MCL than both tetrachloroethylene and trichloroethylene.

I guess the lesson learned there is that even when you follow the rules, somebody can get hurt.

And in this case, nobody expected a volatile organic compound to be in a potable drinking water system that was distributed to, you know, tens of thousands of people.

And so, you know, to say that you have no concerns about an injection of a, of a constituent that exceeds the Florida DEP MCL, I would not agree with that. And the MCL --

CHAIRMAN HAWKENS: May I interrupt. I would agree with that also, and I think Dr. Teaf would agree with you.

If that was said outside the context, I think what he was saying, he had objection here where it had exceed the Florida MCL, but was in fact was below the federal EPA MCL. So I think it's important to keep that in mind.

MR. QUARLES: Oh, okay. Right, right. So in this case, what usually happens, what does happen is states have the opportunity to set a primary drinking water standard equal to or more stringent than the federal standard, and they take into consideration state-specific conditions.

And I would not doubt, I've not read, you know, in the background of why the EPA decided to choose a lower standard, but perhaps it's related to the reliance upon drinking water, groundwater for drinking water.

With filtration and disinfection being really the only sort of treatment that is most typical for potable water supply in Florida.

So just the prevalence of reliance of groundwater to drinking water standard, perhaps could explain that more stringent position.

So thank you for listening to that long explanation, but I tend to take things a little bit more seriously and conservative because I was a guy, for example, at that case, that got calls from the mothers who had these children who had birth defects who had to live with the guilt that perhaps they had done something to cause their child to be, to have a cleft palate, cleft lip, when in fact it could've been as simple as drinking water from the tap that exceeded the standard.

CHAIRMAN HAWKENS: All right. I'm going to, one second, please.

(Off the record comments.)

DR. BURNETT: Dr. Teaf, you mentioned that much of the Upper Floridan aquifer is brackish and to be used as a drinking water source, desalination is required.

And you implied that during that process, which would be, I assume, reverse osmosis, that the four constituents, if present, would be removed at that step.

Has that ever been looked at? Do we know if reverse osmosis can remove these volatile components?

DR. TEAF: I didn't mean to be that specific. Let me, let me say that it's certainly true that in that instance, for reverse osmosis and/or manifolding with water from the Biscayne aquifer can occur.

I'm not specifically familiar with the effectiveness of removal of these chlorinates by reverse osmosis.

But what are certain to be single digit or fractional microgram per liter concentrations, there's virtually no dilution required at all to meet drinking water standards.

DR. BURNETT: Thank you.

DR. TEAF: Yes, sir. Could I make a comment, sir? It's just in response to Mr. Quarles.

CHAIRMAN HAWKENS: Yes, please.

DR. TEAF: I'm familiar with the situation that he described, and I think to put a sort of a period at the end of the sentence, the Center for Disease Control did not conclude that there was a relationship between the groundwater contamination and the cleft palates in that instance. So it's a sad story. It's a terrible story. It's simply not relevant.

CHAIRMAN HAWKENS: All right. Thank you. I think Mr. Quarles looks like he has a response.

MR. QUARLES: I do. In fact, one of the great mistakes was made by the CDC in that they concluded that the potable drinking water well was not used and could not have been related to the TSE in the groundwater because it was not distributed, it was not used and it was not distributed to the entire country.

And in fact, kind of made the argument that there were other water utility districts who people, where they live, where they work, you know, have these birth defects.

So therefore, there couldn't have been a cause and effect, when in fact, this potable supply well was used, that finished water was sold to other utility districts.

So there is some commonality between the TSE and the distribution of water. So the CDC made a real grave mistake in their evaluation of the facts of the case.

CHAIRMAN HAWKENS: Thank you. It's interesting anecdotal information. It's not here to be how relevant or how material, if it is relevant to this case it is, but thank you for bringing it to our attention. And Dr. Teaf, thank you for clarifying it as well.

At this point, if you'll remember, and I mentioned this morning, the city of the Homestead likes to shut down at 5:00, and if we're going to do that, I'd like to make sure everybody has time to pick up and exit the facility so we don't wear out our welcome.

So I would suggest we adjourn for today and I think we can start early tomorrow. If we have probably another half an hour on this topic, and then we'll have the final topic to be followed then by providing lists of additional questions if Counsel have any, and then closing statements.

I would suggest we start no later than 9:00. We could start earlier if Counsel are amenable. Let me start with Ms. Curran.

MS. CURRAN: 9:00 will work fine for us. Thank you.

CHAIRMAN HAWKENS: Mr. Lepre, is 9:00 good for you?

MR. LEPRE: 9:00 is fine. Earlier is fine as well.

CHAIRMAN HAWKENS: All right.

MS. WRIGHT: Yes, 9:00 works. I also have a question. Does the Board have any idea how long Panel 5 questioning may take? NRC staff witnesses have travel arrangements that may need to be changed.

CHAIRMAN HAWKENS: I'd say, I'd say at least an hour.

(Off the record comments.)

CHAIRMAN HAWKENS: We contemplate an hour and a half max for Panel 5.

MS. WRIGHT: Okay, thank you.

CHAIRMAN HAWKENS: Okay. In fact, we'll make sure it does not exceed an hour and a half.

MS. WRIGHT: Thank you very much.

CHAIRMAN HAWKENS: We will adjourn. As we mentioned earlier, if you wish, you may leave material here.

It will be locked, but the city cannot take responsibility for anything that's left behind. We are adjourned. Thank you.

(Whereupon, the above-entitled matter went off the record at 4:44 p.m.)