UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)		
	)	Docket Nos.	52-029-COL
Progress Energy Florida, Inc.	)		52-030-COL
	)		
(Combined License Application for	)		
Levy County Nuclear Plant, Units 1 and 2)	)	ASLBP No.	09-879-04-COL

PRE-FILED DIRECT TESTIMONY OF KEVIN M. ROBERTSON, PhD REGARDING IMPACTS ON WATER QUALITY AND THE AQUATIC ENVIRONMENT DUE TO INCREASED NUTRIENTS RESULTING FROM DESTRUCTIVE WILDFIRES ALLEGEDLY CAUSED BY DEWATERING

I. BACKGROUND AND PROFESSIONAL QUALIFICATIONS

Q1. Please state your name and business address.

A1. My name is Dr. Kevin M. Robertson. My business address is 3205 Triton Circle, Tallahassee, FL 32312.

Q2. Please state your employer and position.

A2. I am a Fire Ecology Research Scientist and the Fire Ecology Program Director at Tall Timbers Research Station and Land Conservancy ("Tall Timbers") in Tallahassee, Florida. Tall Timbers is recognized in the scientific and conservation communities as the birthplace of the study of fire ecology. Its mission is to foster exemplary land stewardship through research, conservation, and education. Among other things, Tall Timbers conducts research focused on ecology and the management of fire-dependent ecosystems and wildlife. Tall Timbers' conservation efforts are dedicated to helping protect the distinctive, rural landscape of South Georgia and North Florida. The research is aimed at understanding the ecosystem processes to inform land management decisions with an objective of maintaining healthy ecosystems. Much of my work for Tall Timbers is devoted to field studies of the effects of fire frequency on biodiversity, wildlife management, and fire hazard reduction.

Q3. Please describe your professional qualifications.

A3. I hold a PhD and an MS in Plant Biology from the University of Illinois at Urbana-Champaign. I also hold a BS in Botany from Louisiana State University. I am a Certified Prescribed Fire Practitioner ("burn boss") in Florida, Georgia, and Mississippi, and have training from eight National Wildfire Coordinating Group courses. I have over 20 years of experience researching, studying and publishing about the ecological impacts of fire. While employed by Tall Timbers, I have performed research and written extensively on the effects of fire regimes on: physical soil properties; estimating fuel consumption for estimating emissions, carbon flux, and fire severity for various fuel types; and the effects of land use on fuel characteristics and fire behavior. I have conducted that research at Tall Timbers, private properties, and federal landholdings, including the Apalachicola National Forest, the Osceola National Forest, and the Okefenokee National Wildlife Refuge. My research has involved habitats including upland pine forests, flatwoods pine forests, sandhill pine forests, cypress depression swamps, and bottomland hardwood forests. I have been awarded numerous grants for conducting wildland fire research. I have served on the steering committees for conferences related to wildland fire, and have served on numerous additional advisory panels and task forces relating to fire management and policy. I have adjunct faculty appointments with five universities through which I have mentored many individuals in the field of fire ecology. I have made over 50 professional presentations on the topic of fire ecology. A more detailed statement of my professional qualifications is provided in my Curriculum Vitae. PEF402.[1]

Q4. What is the purpose of your testimony?

A4. The purpose of my testimony is to address Contention 4A, Part A, Section 5 as admitted by the Nuclear Regulatory Commission's ("NRC") Atomic Safety and Licensing Board ("ASLB") in the Levy County Nuclear Power Plant, Units 1 and 2 ("LNP") Combined Construction Permit and Operating License ("COL") proceeding. As certified by the ASLB, Section 5 of Part A of Contention 4A alleges that "[t]he Draft Environmental Impact Statement (DEIS) fails to comply with 10 C.F.R. Part 51 and the National Environmental Policy Act because it fails to specifically and adequately address, and inap-

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1 For the convenience of the reader, PEF401 lists selected acronyms from this testimony and their meaning.

propriately characterizes as SMALL, certain direct, indirect and cumulative impacts, onsite and offsite, of constructing and operating the proposed LNP [including] … Impacts on water quality and the aquatic environment due to increased nutrients resulting from destructive wildfires resulting from dewatering."

Q5. Are you knowledgeable of matters related to Contention 4A, Part A, Section 5?

A5. Yes. I am knowledgeable of technical issues relating to the causes of wildfires, the severity of wildfires, and the impacts of wildfires on the environment, including fuel consumption and changes in soil chemistry.

Q6. What has been your role in the LNP relevant to Contention 4A, Part A, Section 5?

A6. I was engaged by Progress Energy Florida, Inc. ("PEF") as an expert to review: (1) the potential impacts of dewatering (active and/or passive) by the LNP on wildfires; and (2) the potential for increased nutrient concentrations from such wildfires impacting water quality and the aquatic environment. I visited the LNP site and performed a review of pertinent literature associated with this topic. I reviewed the affidavits submitted previously in this proceeding by Dr. Sydney Bacchus. I applied my education, training, experience and expertise to provide my analysis and opinions.

Q7. What is your understanding of the technical issues raised by Contention 4A, Part A, Section 5?

A7. I understand that Contention 4A, Part A, Section 5 raises the issue of whether dewatering (either active or passive) resulting from the construction and operation of the LNP would promote destructive wildfires which would increase nutrient concentrations and impact water quality and the aquatic environment of wetlands, floodplains, special aquatic sites, and other waters onsite and offsite at the LNP.

Q8. What physical areas surrounding the LNP did you consider in your analysis?

A8. Part A, Section 5 of the Contention relates to potential water table drawdowns, onsite and offsite, from passive and active dewatering associated with construction and operation of the LNP. As presented in Dr. Mitchell Griffin's testimony, there will be no net passive dewatering. PEF001 at p. 26. Based on the FEIS, the area that may potentially be impacted from active dewatering by the water supply wells includes most of the LNP site as well as areas off the LNP site. It is my understanding that PEF initially prepared a groundwater model regarding potential water table drawdowns from active dewatering by the LNP, which PEF "recalibrated" as requested by the NRC. It is also my understanding that, as set forth in the testimony of James Rumbaugh, Jeffrey Lehnen and Dr. William Dunn, PEF believes that its initial model produced more realistic results than the recalibrated model. Without endorsing the recalibrated model's results, I decided, as a worst case scenario, to examine the impacts of wildfires based on the recalibrated model. More specifically, as set forth in the FEIS, the recalibrated model predicts a drawdown of 0.5 ft to greater than 2.5 ft over a total of approximately 7,300 acres onsite and offsite. NRC001, Figure 5-5, at p. 5-28, and Section 5.3.1.1, at p. 5-31. Furthermore, it is my understanding that drawdowns less than 0.5 ft were not reported in the FEIS as an impact. In my professional opinion, average drawdowns less than 0.5 ft will not impact wildfire frequency or severity given their very small magnitude relative to natural hydrological fluctuations. Accordingly, my testimony will analyze wildfires within the approximate 7,300 acre drawdown identified in the FEIS, and my testimony will refer to that area as the "worst case drawdown area."

Q9. Have you determined what portions of the approximately 7,300 acres within the worst case drawdown area are impacted by the various drawdown levels?

A9. Yes. I estimate that the 7,300 acres can be broken down approximately as follows: 0.5-1 ft maximum drawdown on 5,139 acres; 1-1.5 ft maximum drawdown on 1,277 acres; 1.5-2 ft maximum drawdown on 701 acres; 2-2.5 ft maximum drawdown on 168 acres; and >2.5 ft maximum drawdown on 12 acres. To determine those estimates, I imported Figure 5.1 from the FEIS (NRC001 at p. 5-6) into ArcMap 9.3 Geographic Information System software, traced the respective worst case drawdown areas to create polygons representing the ranges of maximum drawdown as described above (outlined in white on PEF403), and used the ArcMap 9.3 software to calculate the areas of the polygons.

II. OVERVIEW

Q10. Please summarize your testimony.

A10. There is no credible scientific link between predicted levels of dewatering (either active or passive) due to the construction and operation of the LNP and an increase in wildfire frequency. It is my professional opinion that there will not be an increase in the frequency of wildfires because the factors that impact fire frequency will be inconsequentially changed by dewatering due to construction and operation of the LNP. Although fire severity in the form of organic soil consumption could be increased in the small portion of the area with organic soil under limited circumstances, it is my professional opinion that the site characteristics would prevent any associated increase in nutrient concentrations in waters and the aquatic environment.

III. WILDFIRE FREQUENCY IS NOT PREDICTED TO CHANGE

Q11. What is a wildfire?

A11. A wildfire is an unwanted and unplanned fire burning in an undeveloped area.

Q12. What are the key factors influencing the frequency of wildfires?

A12. For the purposes of this testimony, wildfire frequency is considered to be the average frequency of fire among locations within the worst case drawdown area. Fire frequency, thus defined, depends on both the number of ignitions within or nearby the area of interest and the ability of fires to spread from the ignition point. The number of ignitions depends on ignition sources (such as lightning strikes, and other anthropogenic sources like automobile exhaust systems, campfires, cigarettes, etc.) and the characteristics of fuels at the location of ignition sources. Factors influencing ability for wildfires to spread are weather conditions, topography, fuel characteristics, natural and man-made barriers to fire spread, and fire suppression.

Q13. Do you expect that ignition sources as a factor influencing wildfires will change due to dewatering resulting from the construction and operation of the LNP?

A13. No. Dewatering does not impact the ignition sources. There is no reason to think that lightning strikes or any other anthropogenic source as described above would increase as the result of water table drawdown by the LNP.

Q14. What are the key aspects of weather conditions that influence the ignition and spread of wildfires?

A14. Recent precipitation, relative humidity, wind speed, incident sunlight, and atmospheric stability are all weather conditions that can influence wildfire ignition and spread.

Q15. Do you expect that the weather conditions as a factor influencing wildfires will change due to dewatering resulting from construction and operation of the LNP?

A15. No. Prevailing weather conditions will not change as a result of dewatering from construction and operation of the LNP.

Q16. Do you expect that topography (natural and man-made barriers to fire spread) or fire suppression as a factor(s) influencing wildfires will change due to dewatering resulting from construction and operation of the LNP?

A16. No. These factors will not change as a result of dewatering from construction and operation of the LNP.

Q17. What are the key aspects of fuel characteristics that influence ignition and spread of wildfires?

A17. Fuel characteristics of importance include fuel composition (*e.g.*, dead grass, organic soil), fuel structure (*e.g.*, vertical compactness, horizontal arrangement), fuel loading (amount of fuel), and fuel moisture. Small diameter, dead fuels (*e.g.*, dead grass, pine needles) when sufficiently dry are most conducive to ignition. Conversely, large diameter or dense fuels (*e.g.*, branches, logs, organic soil) are not conducive to ignition, with the exception that lightning can ignite large woody material because of its exceptionally large amount of energy. Small diameter, dead fuels and live wetland evergreen shrubs (*e.g.*, saw palmetto, gallberry) when horizontally arranged in a continuous manner promote spread of surface wildfire. Organic soil, when sufficiently dry, burns through smoldering combustion with an extremely slow rate of spread.

Q18. What types of soil and potential sources of fuel for wildfires are present in the worst case drawdown area?

A18. The worst case drawdown area, as described above, includes two basic categories of soil types: sandy soil and organic soil. These soil types contain four primary fuel loading areas as I describe below.

Q19. Please describe the nature of the sandy soil in the worst case drawdown area.

A19. The sandy soil areas are characterized by deep sands with little to no organic material. They generally consist of areas that are, or were formerly, flatwoods communities. They are topographically flat, represent the highest surface elevations within and surrounding the LNP, and do not include local surface depressions (e.g., cypress depressions). According to my field observations, sandy soil areas are covered by three general fuel types: (1) planted pine and recently clearcut areas; (2) unplanted pine and hardwood forest; and (3) prairies, marshes, and savannas. These fuel types have fuel beds composed primarily of pine needles and living and dead herbs which carry low severity surface fires. In total, sandy soil areas comprise approximately 82% of the 7,300-acre worst case drawdown area.

Q20. How did you determine that 82% of the worst case drawdown area is comprised of sandy soils?

A20. I superimposed the map of the worst case drawdown area described in the FEIS (NRC001, Figure 5-1, at p. 5-6) onto maps from the Natural Resources Conservation Service Levy County Soil Survey using ArcMap 9.3 Geographic Information System software. I then created a new map layer by tracing the soil units within the worst case drawdown area that contain organic soil (shown in the yellow areas on PEF403). Finally, I used the software to sum the number of acres in those units versus other (sandy soil) units.

Q21. Will changes in the water table attributable to dewatering (active and/or passive) from the construction and operation of the LNP change the *frequency* of wildfires in the sandy soil areas?

A21. It is my professional opinion that they will not. The soil structure in those areas is nearly pure sand with no subsurface impermeable layer. This type of soil neither retains nor wicks up moisture from the water table. Thus, when the water table is below the soil surface, and there has been no recent precipitation, the surface soils and associated litter fuels are dry and available for combustion by ignition or fire spread regardless of the water table's depth. Conversely, ignition and fire spread is very unlikely when the water table is at or above the soil surface. Under current conditions (i.e., before construction and operation of the LNP), the water table in the sandy soil areas is at or above the soil surface for a very small portion of the year. A further reduction in the percentage of time that the water table is at or above the soil surface would negligibly increase the portion of the year when fuels are available for ignition. Thus, changes in the depth of the water table – including any such changes attributable to the LNP – in my professional opinion, would not impact fire frequency in sandy soil areas, which compose 82% of the worst case drawdown area.

Q22. Will changes in the water table attributable to dewatering (active and/or passive) from the construction and operation of the LNP change the *severity* of wildfires in the sandy soil areas?

A22. It is my professional opinion that they will not. For the same reasons that changes in the water table attributable to the LNP would not impact the frequency of wildfires in the sandy soil areas, I predict that such changes in the water table would not increase the severity of wildfires in those areas. Specifically, since the depth of the water table below the soil surface should not effect the surface fuel moisture, and the water table is below the soil surface the great majority of the time, the depth of the water table will not influence fuel consumption in the case of wildfire.

Q23. Please describe the nature of the organic soil at the LNP site and worst case drawdown area.

A23. Organic soil occurs within sandy soil/organic soil complexes (the yellow areas on PEF403), which occupy approximately 18% of the worst case drawdown area. These complexes, based on my field observations, within the worst case drawdown area, are essentially equivalent to cypress depressions. Given that this soil type is a sandy soil/organic soil complex, an even smaller area is actually covered only by organic soil. Organic soil is the fourth type of fuel loading in the worst case drawdown area. (The other three types are set forth in my answer to Question 19 above). The fuel bed is organic soil, herbs, and a mixture of needle and broadleaf litter of varying thickness.

Q24. Will changes in the water table attributable to dewatering (active and/or passive) by construction and operation of the LNP, change the *severity* of wildfires in the organic soils areas?

A24. Fire severity in organic soils varies with the depth to which the soil is dried out at the time of the fire. Thus, a decrease in elevation of the water table, followed by sufficient time for the organic soil above the water table to dry out, might increase consumption of organic soil in the case of a wildfire. However, the effect of decreasing the elevation of the water table on organic soil consumption in the worst case drawdown area would be minimized because (1) based on my field observations, the depth of organic soils in most places is very shallow (a few centimeters), thus limiting the amount of organic soil available for consumption; (2) organic soil dries very slowly from the surface downward over the course of several days or weeks during periods of water table recession; (3) there will be times of the year when the soil would be saturated or completely dry regardless of dewatering due to the LNP because of natural hydrological fluctuations; and (4) precipitation wets organic soil from above and makes it unavailable for combustion independent of water table level. Moreover, most of the area covered by the organic soil complex within the worst case drawdown area is within the area predicted to be drawn down only 0.5-1 ft in the worst case scenario. Also, given the fact that periodic droughts causing complete drying of organic soil are natural, even the most severe wildfire under the worst-case predicted water table drawdown would be within the range of historic natural conditions. For example, as reported in the FEIS, water fluctuations in USGS wells nearby the LNP site have, over a monitoring period from January 1968 through

October 2008, recorded water table fluctuations from the soil surface to 6.5-7.7 ft depth. NRC001, Section 2.3.1.2, at p. 2-28, well below the greatest depth of organic soil that I observed on the site. Therefore, in my professional opinion, predicted changes in the water table attributable to dewatering from the LNP in the worst case drawdown area would have minimal, isolated, and infrequent effects on fire severity, and any effects would be within the range of the natural ecosystem cycle of organic soil consumption.

Q25. Will changes in the water table attributable to dewatering (active and/or passive) from the construction and operation of the LNP change the *frequency* of wildfires in the organic soils areas?

A25. Such an effect would be extremely unlikely. Organic soils are rarely the location of fire ignition, as they are dense and not prone to ignition by sources with short duration of heating (*e.g.*, lightning). Rather, organic soils are generally combusted from fire spreading from adjacent areas. Thus, the frequency of introduction of fire into organic soil areas will be strongly associated with fire frequency in the sandy soil areas, which is not expected to change. The ability for fire to spread through organic soil areas could be influenced by lowering the water table, because lowering the water table would influence the amount of time that the organic soil was saturated versus dry. However, the effect of water table drawdown by the LNP on fire spread would be minimized by the same factors that, as explained above, minimize the effects of organic fuel consumption, namely: (1) generally shallow organic soil; (2) high water retention; (3) high natural fluctuation of water table; and (4) precipitation. In addition, in areas where organic soils are consumed, the surface elevation is lowered, making it less available for subsequent combustion and thus reducing subsequent fire frequency. In any case, the areas covered by organic soil complexes are small and spatially isolated within the larger worst case drawdown area, such that an increase in frequency of spread of fire over areas with organic surface soil in the case of wildfire would have little influence on fire frequency in the area of interest as a whole. Therefore, in my professional opinion, the frequency of wildfires in organic soil areas is not expected to noticeably change due to dewatering by the LNP.

IV. NUTRIENT CONCENTRATIONS IN SURFACE AND GROUND WATERS AND THE AQUATIC ENVIRONMENT

Q26. What are the key factors influencing the amount of nutrients that are added to surface water and the aquatic environment during wildfires?

A26. The key factors are: the amount of fuel consumed; the dominant phase of combustion (smoldering versus flaming); extent of area burned; slope of burned surface; permeability of soil; and depth of permeable soil (water absorption capacity and likelihood of overland runoff).

Q27. What are the mechanisms by which wildfires may add nutrients to water and the aquatic environment of wetlands, floodplains, special aquatic sites, and other waters?

A27. Nutrients are mobilized through wildfires by conversion of a portion of the consumed fuel to mineralized nutrients, some of which are water soluble and thus contained in soil water. There are no streams within the worst case drawdown area by which nutrients could be laterally transported to offsite waters. NRC001, Section 2.2.1, at p. 2-5. However, nutrients mobilized by wildfire could in theory be laterally transported to water bodies by: (1) surface water flow; (2) vertical leaching to groundwater followed by lateral transport to adjacent water bodies through groundwater flow; and (3) mobilization through airborne ash and subsequent deposition on water bodies.

Q28. Does the geography of the worst case drawdown area support lateral transport of nutrients by surface water flow?

A28. Characteristics of the worst case drawdown area are not conducive to lateral transport of nutrients by surface water flow. The worst case drawdown area is very flat. NRC001, Section 2.2.1, at pp. 2-5 and 2-7. Accordingly, any mobilized nutrients would not likely be transported by overland flow of water, especially given the high permeability of the sandy soils in that area. In the case of an exceptionally strong or prolonged precipitation event causing an entire area to be temporarily inundated, some lateral surface flow is possible. However, soil absorption capacity would be highest at the time that wildfire is most likely, i.e., dry or droughty conditions, such that overland flow is unlikely to occur soon after a wildfire. Additionally, such a large amount of water required for inundation would result in extreme dilution of nutrients. Most soil water loss is due to evaporation and transpiration and does not involve lateral transport. Overland transport from organic soil areas to water bodies outside of the burned area generally will not occur (except in