NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD
Before Administrative Judges:
Alex S. Karlin, Chairman
Dr. Anthony J. Baratta
Dr. Randall J. Charbeneau

In the Matter of:	)	
PROGRESS ENERGY FLORIDA, INC.	)	
(Levy County Nuclear Power Plant, Units 1 and 2)	)	Docket Nos.
	)	52-029-COL,
	)	52-030-COL
	)	July 31, 2012

REBUTTAL TESTIMONY OF DR. SYDNEY BACCHUS IN SUPPORT OF CONTENTION C-4 REGARDING ENVIRONMENTAL IMPACTS OF LEVY UNITS 1 AND 2 ON WATER RESOURCES AND HYDROECOLOGY

I. INTRODUCTION AND PURPOSE OF TESTIMONY

Q.1. Please state your name.

A.1. My name is Sydney Bacchus.

Q.2. What is your educational background and experience?

A.2. I am a hydroecologist with a multi-disciplinary doctoral degree in the fields of hydrology, ecology and plant pathology, specializing in the assessment of environmental impacts in the southeastern coastal plains physiographic province of the United States. My educational background and experience are described in response to Questions 1 and 2 of my Initial Pre-filed Testimony that was served on the Atomic Safety and Licensing Board ("ASLB") and the parties on June 26, 2012.

Q.3. What is the purpose of your Rebuttal Testimony?

A.3. The purpose of my Rebuttal Testimony is to respond to incorrect and unsupported statements in the June 26, 2012 testimony by Progress Energy Florida ("PEF") and the U.S.

Exhibit INT801
July 31, 2012

Nuclear Regulatory Commission ("NRC") that were submitted to the ASLB on June 26, 2012 and that I reviewed.

Q.4. Does the testimony by PEF or the NRC Staff contain any new information that is not in the Final Environmental Impact Statement for Levy Nuclear Plant **("LNP")?**

A.4. Yes. The Final Environmental Impact Statement ("FEIS") indicated that PEF would be required to establish an Aquifer Performance Testing Plan ("APT Plan"), an Environmental Monitoring Plan ("EMP"), and if necessary, an Alternative Water Supply Plan ("AWS Plan"), but none of those plans was included in the FEIS as required for a complete FEIS. After the FEIS was released, PEF produced an APT Plan and an EMP as attachments to testimony it submitted and those plans were discussed by PEF witness William J. Dunn. The EMP was called the "Levy Nuclear Plant Well Field Environmental Monitoring Plan." Although PEF did not submit an AWS Plan with its testimony, Dunn's testimony discusses the potential content of the AWS Plan.

Q.5 Have you reviewed the "Levy Nuclear Plant Well Field Environmental Monitoring Plan" ("EMP") dated May 2012 that was prepared by CH2M Hill for PEF?

A. 5 Yes, I have.

Q.6. Please describe your opinions regarding the adequacy of the EMP.

A.6. According to PEF (SoP at 31), the purpose of the EMP is to "provide a framework for monitoring the hydrology and ecology in the vicinity of the LNP site that potentially could be affected by operation of the LNP's wellfield." Although the EMP has significant inadequacies that prevent it from providing that "framework" my opinions provided in this rebuttal testimony will address only a few examples, rather than attempting to provide a comprehensive analysis of those inadequacies which is more appropriate as comments for the required supplemental DEIS. Specifically, the EMP fails to provide the precise locations that would be monitored; implies that monitoring would be confined to the proposed LNP site, excluding the surrounding vicinity;

excludes monitoring of groundwater discharges and water quality from nearby springs and throughout Gulf Hammock, such as the springs discharging along the Withlacoochee canal and King Springs; includes only on-site wetland habitats; fails to acknowledge the existence of supply well #5 in the LNP north parcel near the adjacent red-cockaded woodpecker nesting trees; and relies on assumptions and presumptions that have no scientific basis, including that existing environmental impacts on the proposed LNP site and surrounding vicinity were caused by the Withlacoochee canal that is referenced in the EMP as the "Cross-Florida Barge Canal," despite clear evidence that those impacts were caused by more recent actions.

First, the EMP failed to consider adequately the influence of preferential flow paths in the local geology on alterations to the natural hydroperiod and thus all of the wildlife habitats throughout the proposed LNP site and surrounding vicinity. The EMP is based on the premise that essentially symmetrical radial drawdown spanning a period of years will occur surrounding the supply wells, also referenced as production wells, in the south parcel and that the drawdown impacts in wetlands "are likely to be detected first" within the "near vicinity of the production wells" (EMP, p. 11).

Examples of those essentially radial simulated drawdowns presumed by the EMP and other new plans are shown in CH2M Hill's Tech Memo Approval Form with Review Date 12/07/09 included as Dr. Hazlett's **Exhibit INT104.** Specifically, that exhibit shows two different drawdown responses from 1.58 MGD withdrawals for the upper Floridan aquifer ("UFA") and the surficial aquifer ("SAS"), included in Figures 28 and 29 of that exhibit, respectively (**Exhibit INT104**, pp. 44 and 45). In reality, the magnitude and extent of the drawdowns in the surficial aquifer will mimic those in the upper Floridan aquifer. That is because the fractures and associated relict sinkholes extending throughout the proposed LNP site and surrounding vicinity will result in

vertical and lateral induced recharge or "capture" of water from the surficial aquifer by the UFA where the proposed groundwater wells will be withdrawing water. Induced recharge, also is known as "capture," has been documented to occur within and between basins in this aquifer system (Bacchus, 2000; **Exhibit INT360**) and is described by Lohman et al., 1988 (p. 3) as follows (emphasis added):

> Water withdrawn artificially from an aquifer is derived from a decrease in storage in the aquifer, **a reduction in the previous discharge from the aquifer, an increase in the recharge, or a combination of these changes** (See Theis, 1940, p. 277.) **The decrease in discharge plus the increase in recharge is termed *capture*.** Capture may occur in the form of **decreases in the ground-water discharge into streams, lakes, and the ocean, or from decreases in that component of evapotranspiration derived from the saturated zone**. After a new artificial withdrawal from the aquifer has begun, the head in the aquifer will continue to decline until the new withdrawal is balanced by capture.

Second, the EMP presumes that potential adverse impacts to wetlands from CH2M Hill's predicted "drawdown" of ground water "are likely to be detected first" within the "near vicinity of the production wells" (EMP p. 11). Therefore, PEF proposes monitoring near production wells, also known as supply wells, although it excludes supply well #5 in the LNP north parcel. That presumption and proposed monitoring method described in CH2M Hill's EMP have been shown to be an inaccurate presumption for depressional wetlands, however, because of the unaddressed impacts of induced recharge and capture, as described by Bacchus et al. (2011, **Exhibit INT802**) and Stewart and Stedje (1990, **Exhibit INT361**). Drawdown impacts in the wetlands and associated upland habitats would occur first along the fracture network and associated relict sinkholes and other karst conduits, and would remain undetected by the proposed EMP.

As a result of the flawed assumptions underlying the EMP, the EMP would fail to detect the LARGE adverse impacts on natural hydroperiods in the area throughout and surrounding the proposed LNP site because those plans are based on the same flawed assumptions of CH2M Hill's

model. Likewise, the EMP and other newly submitted plans would fail to detect the LARGE adverse environmental impacts, including degraded water quality, on Big and Little King Springs and the numerous small springs discharging ground water to the Withlacoochee canal from hydroperiod alterations resulting from proposed activities such as the change in flow induced by the construction of the nuclear island for the same reason, despite claims by the NRC Staff (SoP at 37). In fact, as described in my pre-filed testimony, impacts to Big and Little King Springs from existing hydroperiod alterations already are LARGE because those impacts have caused Spring Run Creek, that previously flowed out of King Springs, to cease flowing.

In my opinion the EMP is extremely significant to the environmental review for LNP because PEF and the NRC Staff propose to rely so heavily on it. In effect, PEF and the NRC Staff are saying that it does not matter whether all of the environmental impacts of LNP are LARGE because those impacts would be detected and cured before those impacts could result in irreversible harm to the environment. As described in my testimony, however, the EMP is ***not*** adequate to detect the inevitable adverse environmental impacts of the proposed LNP on wetlands, other wildlife habitat, threatened and endangered species, water quality and natural hydroperiods before those impacts become irreversible.

Considering the magnitude of reliance by PEF and the NRC Staff on the EMP and the lack of scientific support for assertions regarding the benefits of the EMP, it is clear that the EMP should have been circulated for public comment in a Draft Environmental Impact Statement ("DEIS"). The ineffectiveness and incompleteness of the EMP also makes it crucial for the DEIS to have offered reasonable alternative water supply options for LPN, but the AWS Plan has not been submitted even to NRC, much less the public. All of these documents should have been included in the discussion of alternatives and mitigation measures in the DEIS.

Q.7. Will the EMP be able to evaluate and document adequately the environmental impacts on the natural hydroperiods throughout the proposed LNP site and surrounding vicinity from the proposed conversion of natural overland flow to stormwater?

A.7. No. Among other deficiencies, CH2M Hill's "dewatering" model did not include the effects of converting natural overland flow to impounded stormwater. Therefore, the simulated drawdowns that should have provided guidance for formulating the EMP cannot be used for that purpose and the NRC Staff's presumptions regarding the effects of stormwater (e.g., SoP at 33) are not supported. In summary, neither the models nor the EMP and other newly submitted plans consider: 1) preferential flow through the myriad types of karst features known to occur on the proposed LNP sites and surrounding vicinity; 2) surfacewater alterations from construction and operation of the proposed LNP; 3) alterations to surface and ground water from existing and other proposed changes; 4) any scientifically based aspects related to how model predictions of physical changes in water will affect chemical and biological components essential for maintaining healthy wetlands and other wildlife habitats.

In addition, the EMP makes no mention of any type of monitoring to assess the impacts from salt drift and deposition on the vegetation and water on the proposed LNP and surrounding vicinity. The EMP's failure to include any type of monitoring of the impacts of salt deposition is a grave omission considering the sensitivity of vegetation to ionic changes, particularly salt, is well established (Kozlowski, 1980). Additionally, the recent adverse impacts from saltwater intrusion on ground water, surface water and vegetation were described in my pre-filed testimony and exhibits, particularly in my Figure 4 (**Exhibit INT343**).

Finally, the EMP (page 17) proposes that CH2M Hill will establish "management thresholds" for mitigation measures that are "based on the SWFWMD approach to establishing minimum flows and levels (MFLs) for palustrine cypress wetlands . . ." In effect, CH2M Hill

proposes to act in the capacity of the SWFWMD because the SWFWMD has failed to establish minimum flows and levels (MFLs) for the aquifer and surface waters in the vicinity of the proposed LNP, as required by Florida law. See A.47 in my pre-filed direct testimony. In my opinion, it is inappropriate for this critical environmental determination to be made (a) in the future, (b) without any input from regulators or the public and (c) by a private entity.

Q.8. In your opinion, would the proposed initiation schedule for monitoring, as described in the EMP, ensure adequate and accurate assessment of adverse impacts from the proposed LNP?

A.8. No. The EMP indicates that monitoring would begin "a minimum of 2 years before operational production wells are installed," regardless of when any other aspects of construction were initiated (EMP, p. 11). The EMP also states that the initial monitoring would be considered "baseline monitoring." In my professional opinion, however, the conditions monitored initially under the EMP cannot be considered as scientifically valid "baseline" conditions because the initial monitoring would not take into account alterations of the natural hydroperiods that have occurred already or would occur during construction.

Q.9. Would the duration of the proposed monitoring ensure adequate and accurate assessment of adverse impacts from the proposed LNP?

A.9. No. Dunn's testimony (p. 32) states that PEF is authorized to "request a release from the requirements of the EMP after five years of monitoring." It is well established, however, that adverse impacts to pond-cypress (*T. asendens*) wetlands using the monitoring methodolgy proposed in the EMP may not be detected until well after 5 years. For example, see Bacchus et al. (2011, **Exhibit INT802**). By the time the monitoring proposed in the EMP detects those adverse impacts those impacts are irreversible, as described in Bacchus et al. (2003; **Exhibit INT366** and 2005; Exhibit INT**803).**

Q.10. In A.106 of the NRC Staff's testimony, NRC Staff witnesses Doub and Aston

acknowledge "uncertainty in the ability of the Applicant's proposed monitoring efforts to detect or predict adverse wetland impacts in time to switch to an alternate water source before noticeable effects ensue." Do you agree with the Staff's conclusion?

A.10. No. In my professional opinion based on more than thirty years of experience, the situation is worse than uncertain. By the time the effects of hydroperiod alterations from water withdrawals and other proposed LNP actions are visible, the damage to the wetlands, other wildlife habitat and water quality is irreversible, as described in my preceding testimony. Therefore, irreversible adverse impacts to wetlands, other wildlife habitat and water quality from the proposed LNP are virtually certain to occur before adverse impacts are detected by any proposed actions in the EMP.

As I indicated in my pre-filed testimony (A.28, 52), there is no evidence that adverse impacts to the pond-cypress wetlands on the proposed LNP site and surrounding vicinity or bald-cypress (*T. distichum*) wetlands in the LNP vicinity can be reversed by the time those impacts are observed by monitoring proposed in the EMP. This is true regardless of whether the adverse impacts result from hydroperiod alterations or salt drift or the cumulative impacts of those stresses. In fact, I have not observed a single case where those types of impacts have been reversed, despite numerous requirements and attempts by agencies and private companies. The detailed scientific basis for my conclusions is provided in the peer-reviewed publications by Bacchus et al. (2003; Exhibit INT366 and 2005; **Exhibit INT803).**

Q.11. Do you have any opinions regarding PEF or NRC Staff proposals to mitigate the environmental impacts of LNP on wetlands?

A.11. Yes. Staff's SoP at 26 references state requirements that applicants compensate for any encroachment on the 100-year floodplain that may result in loss of flood storage. This is an engineering requirement that does not "compensate" for adverse impacts to wetlands other wildlife habitat or any other adverse environmental impacts. In fact, that engineering-related compensation results in additional, more severe and irreversible adverse impacts to wetlands for reasons that I

described in detail in my pre-filed testimony (A.51) and in my 2006 peer-reviewed publication (Bacchus, 2006; **Exhibit INT363**).

In addition, the EMP proposes to "deepen production wells" as a mitigation measure in the EMP (p. 26). This alternative would not eliminate the induced recharge and capture described in Answer 6 in this rebuttal testimony because water still would be pulled downward from the surficial aquifer and laterally from surrounding springs, streams and other surface waters in the vicinity, such as the numerous springs discharging into the Withlacoochee canal. Induced recharge from the proposed LNP groundwater withdrawals also would result in induced saltwater intrusion from the coast and would increase the potential for contamination of the aquifer system due to upcoming, or upward induced recharge, of more saline water at deeper intervals.

Q.12. Do you swear in accordance with 28 U.S.C. § 1746, under penalty of perjury, that this testimony is true and correct?

A.12. Yes I do.

Executed in accord with 10 C.F.R. § 2.304(d)

Electronically signed by
Sydney T. Bacchus
Applied Environmental Services, LLC
P.O. Box 174
Athens, GA 30603-0174

Publications Cited

Bacchus, S. T. (2000). Uncalculated impacts of unsustainable aquifer yield including evidence of subsurface interbasin flow. *Journal of American Water Resources Association* 36(3), 457-481.

Bacchus, S. T. (2006). Nonmechanical dewatering of the regional Floridan aquifer system. In Harmon, R. S. & C. Wicks (Eds.), *Perspectives on karst geomorphology, hydrology, and geochemistry – A tribute volume to Derek C. Ford and William B. White* (pp. 219-234). Geological Society of America Special Paper 404.

Bacchus, S. T., D. D. Archibald, K. O. Britton, & B. L. Haines (2005). Near infrared model development for pond-cypress subjected to chronic water stress and *Botryosphaeria rhodina*. Acta Phytopathologica et Entomologica Hungarica 40 (2-3):251-265.

Bacchus, S. T., D. D. Archibald, G. A. Brook, K. O. Britton, B. L. Haines, S. L. Rathbun, & M. Madden (2003). Near infrared spectroscopy of a hydroecological indicator: New tool for

determining sustainable yield for Floridan aquifer system. Hydrological Processes 17:1785-1809.

Bacchus, S., Masour, J., Madden, M., Jordan, T. & Meng, Q. (2011). Geospatial analysis of depressional wetlands near Peace River watershed phosphate mines, Florida, USA. *Environmental and Engineering Geoscience* 17(4), 391-415.

Kozlowski, T.T. (Ed.) (1980). Responses of Plants to Environmental Stresses: Vol. II Water, Radiation, Salt, & Other Stresses. 2nd Edition. Physiological Ecology. Academic Press. NY.

Lohman, S.W., Bennett, Brown, R.H., Cooper, Jr., H.H., Drescher, W.J., Ferris, J.G., & Johnson, A.I. (1988). Definitions of Selected Ground-water Terms – Revisions and Conceptual Refinements.. U.S. Geological Survey Water Supply Paper 1988. pp. 21.

Stewart, M. T. & Stedje, D. (1990). Geophysical Investigation of Cypress Domes, West Central Florida. *Prepared by University of South Florida Geology Department for Southwest Florida Water Management District*. Brooksville, FL, pp. 103.