Progress Energy

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

Subject: **Levy Nuclear Plant Units 1 and 2 (LNP)**
NRC Project Number 756
LNP COLA Supplemental Information

Ladies and Gentlemen:

Progress Energy – Florida submitted an application, dated July 30, 2008, for a combined license (COLA) for two AP1000 passive pressurized water reactors to be located at the Levy Nuclear Plant site in Levy County, Florida.

In a conference call on September 5, 2008, NRC staff identified items that the NRC staff stated were required to support the NRC sufficiency review of the LNP COLA. These items include:

1. Limited Work Authorization (LWA):

   a. LWA scope must be revised to include the Diaphragm Wall and Grouting required for excavation.

   b. More detailed description must be provided for the activities requested by LWA.

   c. The LWA should identify, by reference, the sections of the COLA that address LWA requirements for FSAR descriptions, ITAAC and Technical qualifications.

   This additional LWA information is provided in Attachment 1. If further NRC review results in a determination that the Diaphragm Wall and Grouting may be conducted as pre-construction work, our intent would be to remove these activities from LWA scope.

2. Geotechnical:

   a. Grouting Program - The FSAR description should address grout design, construction grout program and post-construction grout testing. The basis for the 75' thickness of the grout and the impact on hydrology due to grouting should also be provided.

   b. RCC – The RCC test program should be described in the COLA. The RCC testing description should also address QA program requirements.

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c. Solution activity – NRC requested that a qualitative discussion regarding dissolution rates be provided.

d. A design description of the Diaphragm Wall needs to be provided.

This additional geotechnical information is provided in Attachment 2.

3. Emergency Plan (EP):

a. NRC requested that Levy and Citrus county emergency plans be provided. The State of Florida Radiological Emergency Management Plan, Annex A, Appendix 1 which is included in the LNP COLA Part 5 provides the state and county emergency response for Crystal River 3. This includes Citrus and Levy Counties. The LNP COLA Part 5 also includes a draft Emergency Plan for the Levy Nuclear Plant which includes emergency response by Levy, Citrus and Marion County.

Copies of the current versions of the Levy and Citrus County Emergency Plans are provided in Attachment 3.

Information provided in Attachments 1, 2 and 3 will be incorporated in a future revision to the LNP COLA as noted in the attachments. If you have any questions, or need additional information, please contact Bob Kitchen at (919) 546-6992, or Garry Miller at (919) 546-6107.

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

Executed on September 12, 2008.

Sincerely,

James Scarola

James Scarola
Senior Vice President and
Chief Nuclear Officer

Attachments:
1. Revisions to Limited Work Authorization Scope
2. Additional information for Geotechnical
3. Additional information for Emergency Plan

cc:

Mr. Brian Anderson, U.S. NRC Project Manager

c *(w/o* attachments):

U.S. NRC Director, Office of New Reactors/NRLPO
U.S. NRC Office of Nuclear Reactor Regulation/NRLPO
U.S. NRC Region II, Regional Administrator

ATTACHMENT 1
ADDITIONAL INFORMATION FOR LIMITED WORK AUTHORIZATION (LWA)

This attachment provides revisions to Part 2, FSAR; Part 3, Environmental Report; Part 6, LWA; and Part 10, Proposed License Conditions (Including ITAAC) to address changes in scope for the LNP LWA authorization request. Enclosure 1 to this attachment provides a reviewer aid to identify LNP's compliance with LWA Rule requirements.

Two activities have been added to the scope of LWA activities based on discussions with the NRC Staff. These are:

- Install and retain perimeter diaphragm wall.
- Install and retain permeation grouting in the Avon Park Formation.

Two activities have been removed from the scope of LWA activities based on additional reviews performed consistent with guidance in the Supplemental ISG on LWA issued by NRC on August 21, 2008. These activities are:

- Install circulating water piping between the cooling tower basins and the entrance point to the turbine building condensers.
- Install the raw water system intake structure and make-up line to the cooling tower basin.

Based on the additional reviews discussed below, these activities are demonstrated to be preconstruction activities. The basis for removing these activities from the scope of LWA activities is provided in the following paragraphs.

Buried Circulating Water System Piping

In the Supplementary Information for the LWA final rule, the NRC states that the criteria in Section 50.10(a) are intended to exclude from the definition of construction activities related to those structures, systems and components described in the FSAR "which do not actually directly affect the radiological health and safety of the public or the common defense and security, and their indirect effect on such health and safety or common defense and security is so low as to be considered negligible."

The Circulating Water System (CWS) for the AP1000 nuclear plant utilized at the LNP site is a cooling system that performs no safety-related function. The CWS provides cooling water to the main turbine condenser to remove heat as part of the power generation steam cycle. Additional cooling is supplied from the CWS through a tap in the main supply header to the Turbine Building Closed Cooling Water (TCS) heat exchangers and the condenser vacuum pump seal water heat exchangers. In particular, the circulating water piping transfers the circulating water from the discharge of the circulating water pumps to the main condenser and from the main condenser back to the cooling tower basin. The design of the CWS is addressed in Subsection 10.4.5 of the LNP FSAR (Part 2 of the COL application). The CWS buried piping up to the turbine building and buried electrical/I&C duct banks to the CWS pump structure are passive non safety-related components whose functions are to provide a flow path for CWS water to facilitate cooling, and a structure to house electrical and I&C cables. Consistent with the guidance in the Supplemental ISG, buried circulating water piping up to the turbine building does not meet the definition of construction in Section 50.10(a). In the event of failure of the buried pipe, leakage prior to shutdown of the system would not be significant and would not result in a plant trip or safety system actuation. The leakage would not undermine any safety-significant SSC as the piping is buried and runs outside the area of the nuclear island. Furthermore, the CWS contains only cooling water, and radioactivity (including tritium) would not be present in the water. The cable duct banks similarly do not have an active failure mechanism that would cause plant trips or safety system actuations. Thus, the CWS piping and cable duct banks are excluded from the scope of construction based on maintenance rule guidance. Circulating water piping is described in the FSAR, but similar to the cooling tower, it does not actually directly affect (and has no "reasonable nexus" to) the radiological health and safety of the public within the meaning of the LWA rule, and any indirect effect on health and safety is so low as to be considered negligible.

The CWS structures identified above are not relied upon for mitigation of accidents and are not used in emergency operating procedures.

Thus, the circulating water system buried piping and cable duct banks do not meet the criteria for construction SSCs in Section 50.10(a)(1) and are considered to be preconstruction activities.

<u>Raw Water System Intake Structure and Makeup Line to the Cooling Tower Basin</u>

The LNP Raw Water System (RWS) intake structure, associated buried makeup piping from the intake structure to the cooling tower basin structure, and buried electrical/I&C cable duct bank from the turbine building to the intake structure, are passive non safety-related components (located outside of the protected area). They provide the structure for the location of equipment and associated piping to provide salt water makeup to the CWS cooling towers and CWS from a designated non-safety salt water source (Cross Florida Barge Canal). They also provide a protected path for power and control cabling. A failure of the Intake Structure, buried piping, or cable duct bank would not directly cause a plant trip and are not directly or indirectly linked to a system that has a nexus to radiological health and safety. The intake structure, buried piping associated with the makeup line from the intake structure to the cooling tower basin structure, and cable duct bank do not meet the definition of construction in Section 50.10(a), because failures of these SSCs would not result in a plant trip or safety system actuation and thus are not considered to be in the scope of construction based on maintenance rule guidance. Failure of the buried makeup piping would result in no significant leakage. No structures are located above the buried piping. Furthermore, the makeup piping contains only cooling water, and radioactivity (including tritium) would not be present in the water.

The RWS structures identified above are not relied upon for mitigation of accidents and are not used in emergency operating procedures.

Thus, the Raw Water System intake structure, makeup line buried piping and the cable duct bank do not meet the criteria for construction SSCs in Section 50.10(a)(1) and are considered to be preconstruction activities.

Part 2, FSAR, Chapter 2, Subsection 2.5.4.5, will be revised to read as follows:

2.5.4.5 Excavations and Backfill

Soil and rock excavations will be required to construct the LNP nuclear islands on rock at a subgrade elevation of approximately -7.3 m (-24 ft.) NAVD88. This subsection describes the anticipated excavation and backfill plans for the nuclear islands, including the planned diaphragm walls, excavation extents and methods, and the properties of backfill beneath and adjacent to safety-related structures.

Construction sequencing for these activities is described in FSAR Subsection 2.5.4.12. A Limited Work Authorization (LWA) has been requested including the following scope:

- Install and retain perimeter diaphragm wall.
- Install and retain permeation grouting in the Avon Park Formation.
- Prepare nuclear island foundation surface with dental concrete.
- Place RCC under the nuclear islands.
- Install mudmat beneath each nuclear island.
- Install waterproofing beneath the mudmat under each nuclear island.
- Install rebar in the nuclear island concrete foundations.
- Erect safety-related concrete placement forms.
- Install Turbine Building, Annex Building, and Radwaste Building foundation drilled shafts.
- ~~Install circulating water piping between the cooling tower basins and the entrance point to the turbine building condensers.~~
- ~~Install the raw water system intake structure and make-up line to the cooling tower basin.~~

Additionally, soils may be excavated as discussed in FSAR Subsection 2.5.4.8.5 in regards to subsurface improvements associated with zones of potential liquefaction.

Part 3, Environmental Report, Section 4.8, will be revised to read as follows:

4.8 ACTIVITIES UNDERTAKEN UNDER A LIMITED WORK AUTHORIZATION

The LWA for the LNP will allow PEF to undertake activities in advance of approval of the COLA for the following items:

Install and retain perimeter diaphragm wall.

Install and retain permeation grouting in the Avon Park Formation.

Prepare nuclear island foundation surface with dental concrete.

Place roller compacted concrete under the nuclear islands.

Install mud mat under the nuclear islands.

Install waterproofing beneath the mud mat under the nuclear islands.

Install rebar in the nuclear island concrete foundations.

Erect safety related concrete placement forms.

Install Turbine Building foundation drilled shafts.

Install Annex Building foundation drilled shafts.

Install Radwaste Building foundation drilled shafts.

~~Install circulating water piping between the cooling tower basins and the entrance point to the turbine building condensers.~~

~~Install the raw water system intake structure and make-up line to the cooling tower basin.~~

The impacts associated with the construction of the LNP (which includes all of the above-described LWA activities) are described in the preceding sections of this chapter and specifically in ER Sections 4.1, 4.2, 4.3, 4.4, and 4.6.

Part 6, Limited Work Authorization, Site Redress Plan, Section 3.1, will be revised to read as follows:

3.1 LIMITED WORK AUTHORIZATION ACTIVITIES

The activities that are allowed or not allowed in accordance with an LWA are specified in 10 CFR 50.10(a).

LWA activities that PEF intends to undertake would be those allowed by 10 CFR 50.10(d)(1) and include the following, any of which may be for an SSC for which a construction permit or a COL is otherwise required:

- Driving of piles.
- Subsurface preparation.
- Placement of backfill, concrete, or permanent retaining walls within an excavation.
- Installation of a foundation, including placement of concrete.

The PEF LWA request is for the full extent of activities allowed by NRC regulation, and the SRP encompasses all such activities. PEF has identified the following LWA activities that are being requested:

- Install and retain perimeter diaphragm ("cut-off") wall. This activity consists of installing reinforced concrete diaphragm walls, prior to excavation, to provide a side barrier (side of the "bathtub") to minimize lateral groundwater flow into the excavation and facilitate dewatering during and following excavation. After construction of the nuclear island, this wall is abandoned. The space between the wall and the nuclear island will be filled in by placement of cementitious fill. The design description and analysis of this activity are found primarily in Part 2, Chapter 2, Subsection 2.5.4.5.1. No ITAAC are proposed for this activity since it screens out when the selection criteria of Part 2, Chapter 14, Subsection 14.3 are applied.

- Install and retain permeation grouting in the Avon Park Formation from -24 ft NAVD88 to -99 ft NAVD88. The grouting program will be undertaken to form the bottom of the "bathtub," and consists of drilling holes prior to excavation through the soil and rock layers, and pumping grout under a controlled process into the limestone layer. The grouting program, like other aspects of excavation, will provide additional information about the subsurface conditions. Numerous boreholes would be drilled and grout uptake monitored in order to provide additional characterization of the subsurface condition. Grouting will minimize seepage from the rock upward into the excavation, and resist possible uplift pressure. A secondary benefit is realized through reduction of long-term groundwater flow in the Avon Park Formation to minimize potential solution impact. The design description and analysis of this activity are found primarily in Part 2, Chapter 2, Subsections 2.5.4.5.1 and 2.5.4.6.2. No ITAAC are proposed for this activity since it screens out when the selection criteria of Part 2, Chapter 14, Subsection 14.3 are applied.

- Prepare nuclear island foundation surface with dental concrete. Following excavation of the overlying soil and rock to approximately -24 ft NAVD88, degraded rock at the top of the Avon Park Formation will be removed or improved, and dental concrete will be installed. The design description and analysis of this activity are found primarily in Part 2, Chapter 2, Subsection 2.5.4.5.3. No ITAAC are proposed for this activity since it screens out when the selection criteria of Part 2, Chapter 14, Subsection 14.3 are applied.

- Place roller compacted concrete (RCC) under the nuclear island foundations. The RCC is a (approximately) 35-foot thick concrete mat placed on top of the improved surface of the Avon Park Formation. The RCC fill (bridging mat) will serve two purposes: 1) replace the weakly cemented, undifferentiated Tertiary sediments that are present above elevation -7.3 m (-24 ft.) NAVD88, thereby, creating a uniform subsurface with increased bearing capacity; and 2) bridge conservatively postulated karst features. The RCC is designed to meet the AP1000 loading conditions while bridging the postulated karst features. The design description and analysis of this activity are found primarily in Part 2, Chapter 2, Subsection 2.5.4.5.4. The site-specific ITAAC for this activity are found in Part 10, Appendix B, Table 3.8-3.

- Install waterproofing beneath the mud mat under the nuclear islands. A waterproofing membrane, designed in accordance with the AP1000 DCD Subsection 3.4.1.1.1.1, is installed on the top surface of the RCC bridging mat and underneath the mud mat for the nuclear island foundation. The waterproof membrane will meet the AP1000 DCD requirements of ≥0.7 static coefficient of friction between the horizontal portion of the membrane and the RCC and mudmat concrete surfaces. The site-specific ITAAC for this activity are found in Part 10, Appendix B, Table 3.8-2.

- Install mud mat under the nuclear islands. A mudmat for the nuclear island foundation, consisting of a six-inch thick unreinforced lean concrete pad, will be poured on top of the waterproof membrane. Design requirements for the mudmat are addressed in the AP1000 DCD, Subsection 2.5.4 and the mudmat is described in more detail in AP1000 DCD, Subsection 3.4.1.1.1. No ITAAC are proposed for this activity since it screens out when the selection criteria of Part 2, Chapter 14, Subsection 14.3 are applied.

- Install rebar in the nuclear island concrete foundations. The reinforcing bar will be installed on the surface of the mudmat in preparation for placement of the nuclear island basemat. The nuclear island basemat will not be placed until the combined license is issued. The reinforcing bar will be installed in accordance with the AP1000 design requirements and confirmed as part of the AP1000 DCD Tier 1, Section 3.3 design requirements and associated ITAAC.

- Erect safety-related concrete placement forms. The erection of concrete placement forms to enable the installation of safety-related concrete in the foundation and sidewalls of the nuclear island will allow the placement of nuclear island reinforced concrete upon the issuance of the combined license. The erection of these forms are a non-safety related activity but will be installed to enable the AP1000 DCD Tier 1 ITAAC for nuclear island foundation and building structure found in Tier 1, Table 3.3-6, to be satisfied.

- Install Turbine Building foundation drilled shafts. The Turbine Building will be founded on deep foundations (4000-psi concrete drilled shafts) that are socketed into the Avon Park Formation. Preliminary settlement analyses indicate that this structure will exhibit very little total settlement (less than 5 millimeter (mm) [0.2in].), and therefore any potential for differential settlement is negligible. Prior to the construction of each drilled shaft, a pilot hole will be drilled to verify the capacity of the rock to resist the imposed loads. The design description and analysis of this activity are found primarily in Part 2, Chapter 2, Subsections 2.5.4.2, 2.5.4.5, 2.5.4.7, 2.5.4.8, and 2.5.4.10. The site-specific ITAAC for this activity are found in Part 10, Appendix B, Table 3.8-4.

- Install Annex Building foundation drilled shafts. The Annex Building (seismic Category II structures) will be founded on deep foundations (4000-psi concrete drilled shafts) that are socketed into the Avon Park Formation. Preliminary settlement analyses indicate that this structure will exhibit very little total settlement (less than 5 millimeter (mm) [0.2in].), and therefore any potential for differential settlement is negligible. Prior to the construction of each drilled shaft, a pilot hole will be drilled to verify the capacity of the rock to resist the imposed loads. The design description and analysis of this activity are found primarily in Part 2, Chapter 2, Subsections 2.5.4.2, 2.5.4.5, 2.5.4.7, 2.5.4.8, and 2.5.4.10. The site-specific ITAAC for this activity are found in Part 10, Appendix B, Table 3.8-4.

- Install Radwaste Building foundation drilled shafts. The Radwaste Building will be founded on deep foundations (4000-psi concrete drilled shafts) that are socketed into the Avon Park Formation. Preliminary settlement analyses indicate that this structure will exhibit very little total settlement (less than 5 millimeter (mm) [0.2in].), and therefore any potential for differential settlement is negligible. Prior to the construction of each drilled shaft, a pilot hole will be drilled to verify the capacity of the rock to resist the imposed loads. The design description and analysis of this activity are found primarily in Part 2, Chapter 2, Subsections 2.5.4.2, 2.5.4.5, 2.5.4.7, 2.5.4.8, and 2.5.4.10. The site-specific ITAAC for this activity are found in Part 10, Appendix B, Table 3.8-4.

- ~~Install circulating water piping between the cooling tower basins and the entrance point to the turbine building condensers.~~[1]

- ~~Install the raw water system intake structure and make-up line to the cooling tower basin.~~[1]

Additional aspects of the LNP site and site characteristics that provide supporting information for the determination of acceptability of the LWA scope of activities are contained in the following sections of Part 2, FSAR, Chapter 2, of the COL application:

- 2.1 – Geography and Demography
- 2.2 – Nearby Industrial, Transportation, and Military Facilities
- 2.3 – Meteorology
- 2.4 – Hydrologic Engineering
- 2.5.1 – Basic Geologic and Seismic Information
- 2.5.2 – Vibratory Ground Motion
- 2.5.3 – Surface Faulting
- 2.5.4.1 – Geologic Features
- 2.5.4.2 – Properties of Subsurface Materials
- 2.5.4.3 – Foundation Interfaces
- 2.5.4.4 – Geophysical Surveys
- 2.5.4.5 – Excavations and Backfill
- 2.5.4.6 – Groundwater Conditions
- 2.5.4.7 – Response of Soil and Rock to Dynamic Loading
- 2.5.4.8 – Liquefaction Potential
- 2.5.4.9 – Earthquake Site Characteristics
- 2.5.4.10 – Static Stability

[1] ~~PEF has determined that there are certain site preparation activities related to circulating water piping and intakes that should be allowed as pre-construction activities, as defined in 10 CFR 50.10, because they are not encompassed by the definition of construction contained in 10 CFR 50.10(a)(1), they do not have a reasonable nexus to radiological health and safety and/or common defense and security, and their indirect effect on such health and safety or common defense and security is so low as to be considered negligible.~~

- 2.5.4.11 – Design Criteria
- 2.5.4.12 – Techniques to Improve Subsurface Conditions
- 2.5.5 – Stability of Slopes

Table 1.0-1 provides a summary of the LNP COLA and its relationship to proposed LWA activities.

Table 1.0-1
Summary of the LNP Combined License Application (COLA) and its Relationship to Proposed LWA Related Activities

LNP COLA Part	LNP COLA Title	Relationship to LWA Activities
1	General and Financial Information	Contains information in Subsection 1.1.3 that describes Progress Energy's experience with construction and operation of nuclear power plants in support of technical qualifications for performance of LNP LWA activities.
2	FSAR	This part describes various aspects related to LWA activities. FSAR Chapter 1, Section 1.1, describes the LWA request; Subsections 1.4.1 and 1.4.2.8 describe the technical qualifications for activities, including LWA activities. FSAR Chapter 2 describes the scope of LWA activities in Subsection 2.5.4.5 and provides the design description and analysis of LWA activities in various subsections of Section 2.5 and Subsection 3.7.1.1.2. Other portions of FSAR Chapter 2 describe supporting site descriptions, design descriptions and analysis for the LNP site. FSAR Chapter 13, Section 13.1, describes the LNP organizational structure and describes technical qualifications in Subsection 13.1.3 for proposed activities, including LWA activities. The Physical Security Plan for construction activities, which includes LWA activities, is described in Section 13.6. FSAR Chapter 14, Section 14.3, describes the ITAAC selection criteria and identifies the site-specific ITAAC for LWA activities. FSAR Chapter 17 and COLA Part 11 describe the Quality Assurance Program for construction, which includes LWA activities.
3	Environmental Report	Areas describing LWA-related activities are identified in Part 6 – Applicant's Environmental Report – Limited Work Authorization Stage
4	Technical Specifications	Not applicable to LWA related activities.
5	Emergency Plan	Not applicable to LWA related activities.
6	Limited Work Authorization and Site Redress Plan	Contains Applicant's Environmental Report – Limited Work Authorization Stage and Site Redress Plan. Scope of LWA activities described in Section 1.3 of the Site Redress Plan.
7	Departures and Exemptions	Not applicable to LWA related activities.
8	Safeguards/Security Plans	Applicable to LWA related activities as described in FSAR Chapter 13, Section 13.6.
9	Withheld Information	Not applicable to LWA related activities.
10	Proposed License Conditions (Including ITAAC)	Proposed License Condition 7 requires LNP to submit an amendment to update FSAR Subsection 1.4.1 to identify the NSSS vendor, architect-engineer, and constructor, describe their technical qualifications, and describe the division of responsibility among them. Appendix B identifies the site-specific ITAAC assigned to LWA activities contained in Tables 3.8-2, 3.8-3 and 3.8-4.
11	Enclosures	The Quality Assurance Program Description is enclosed, which describes the program to be used by LNP during construction.

Part 2, FSAR, Subsection 14.3.3, will be revised to add a new subsection 14.3.3.3, to read as follows:

14.3.3.3 Turbine Building, Radwaste Building, and Annex Building Drilled Shafts ITAAC

The design of the drilled shafts to support the Turbine Building, Radwaste Building, and Annex Building foundations and structures is described in Subsections 2.5.4.8 and 2.5.4.10. ITAAC for these buildings have been developed to address verification of the physical arrangements of the drilled shaft foundations.

Part 10, Proposed License Conditions (Including ITAAC), Appendix B, Inspections, Tests, Analysis and Acceptance Criteria, will be revised as follows:

Turbine Building, Radwaste Building, and Annex Building Drilled Shaft Foundations

The ITAAC that are applicable to the drilled shaft foundations that support these buildings are included in attached Table 3.8-4.

At the end of Appendix B, add Table 3.8-4, to read as follows:

Table 3.8-4
Drilled Shaft Foundation Inspections, Tests, Analyses, and Acceptance Criteria
(Sheet 1 of 1)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
Drilled Shaft Foundations for the Turbine, Radwaste, and Annex Buildings will preclude movement in excess of the separation provided between the structural elements of the Turbine, Radwaste, and Annex buildings and the nuclear island structures	Inspection of the as built drilled shaft foundation physical arrangement will be performed	A report exists that reconciles the as built physical arrangement of the drilled shaft foundations for the Turbine, Radwaste, and Annex Buildings with the design drawings.

ENCLOSURE 1
Matrix of LNP Compliance with LWA Rule Requirements

Rule Section	Requirement Summary	LNP Compliance in COLA
2.101(a)(1)	Application filing – file with Director, ONR	LNP Application filed with Michael Johnson, Director, ONR, on July 30, 2008
2.101(a)(2)	Acceptability determination for docketing of application	N/A – Applicable to NRC
2.101(a)(3)	Docketing of application	N/A – Applicable to NRC
2.101(a)(4)	Provision of additional copies of application and affidavit of distribution to Federal, State and local officials within 10 days of docketing	Future action required of LNP after acceptance review and docketing
2.101(a)(5)	Two-part filing of application	NA to LNP – LNP filed as a complete and integrated application
2.101(a)(9)	Applicant for combined license under part 52 may submit a complete application under paragraphs (a)(1) through (a)(4) of 2.101 which includes the information required by §50.10(d)	Applicable to LNP – application for COL includes information required by §50.10(d); the alternative for a two part application identified in 2.101(a)(9)(i) and (ii) is NA to LNP
2.102(a)	NRC request for additional information and schedule for application review	N/A – applicable to NRC; LNP will provide additional information as requested
2.104(a)	Notice of request for hearing	N/A – applicable to NRC
2.104(c)(1)	Transmittal of notice of hearing to state and local officials	N/A – applicable to NRC
2.600	Scope of Subpart F	NA – LWA activities under §50.10(d) included in scope
2.600(d)	Applicability of procedures in §§2.641 through 2.649 to phased applications for CPs or COLs which request LWAs to be issued	Applicable to LNP – request addressed in submittal letter NPD-NRC-2008-22 and in Part 2, Chapter 1, Section 1.1
2.606	Application of regulatory requirements in other parts to any partial initial decision rendered	N/A – applicable to NRC
2.641	Filing fees	Applicable to LNP
2.643(a)	Treatment of each part of an application under 2.101(a)(9) as tendered application and notification of applicant if application is deficient	NA – applicable to NRC
2.643(b)	Docketing of part one of an application submitted under 2.101(a)(9) and completeness of part one (e.g., contains information required by 50.10(d)(3))	NA to LNP – application is combined license application and includes LWA authorization request
2.643(c)	Notice of docketing of part one	N/A – applicable to NRC
2.643(d)	Docketing of part two of the application if determined to be complete	NA to LNP – application is combined license application and includes LWA authorization request
2.643(e)	Notice of docketing of part two	N/A – applicable to NRC
2.645(a)	Notice of hearing for part one of application	N/A – applicable to NRC (not applicable to LNP – no part one and part two; application is combined license application and includes LWA

Rule Section	Requirement Summary	LNP Compliance in COLA
		authorization request)
2.645(b)	Notice of hearing for part two of application and petitions to intervene	N/A – applicable to NRC (not applicable to LNP – no part one and part two)
2.645(c)	Intervention requirements on remaining unresolved issues beyond LWA	N/A – applicable to NRC and interveners
2.645(d)	Non-timely petitions for intervention	N/A – applicable to NRC
2.645(e)	Membership of ASLBs	N/A – applicable to NRC
2.649	Partial decision on LWA – a limited work authorization may not be issued under 10 CFR 50.10(d) without completion of the review for limited work authorizations required by subpart A of part 51 of this chapter	N/A – applicable to NRC
50.10(a)(1)	Definition of *construction* for the purposes of the LWA – activities constituting construction	Activities constituting construction have been defined in Part 6 (LWA Requests) of the LNP COLA, Site Redress Plan, Section 1.3
50.10(a)(2)	Definition of *construction* for the purposes of the LWA – activities not included in construction	Listed activities apply to LNP. Also proposed as activities not included in construction (e.g., preconstruction), but not identified in either definitions 50.10(a)(1) or 50.10(a)(2) are SSCs such as buried circulating water piping between the cooling tower basin and the turbine building, and the intake structure and associated makeup water piping from the intake structure to the cooling tower basin
50.10(b)	Requirement for license	Applicable to LNP. A license issued by the Commission is required to conduct any of the listed activities
50.10(c)	Requirement for permits, licenses or authorizations	Applicable to LNP. The issuance of a LWA under 50.10(d) is required before beginning construction of a production facility
50.10(d)(1)	Request for LWA	LNP has requested a LWA in NPD-NRC-2008-22 and in Part 2, FSAR chapter 1, Section 1.1 to perform the scope of activities identified in Part 6 (LWA Requests) of the LNP COLA, Site Redress Plan, Section 1.3
50.10(d)(2)	An application for a LWA may be submitted as part of a complete application for a construction permit or combined license	Applicable to LNP - LNP filed LWA as part of a complete and integrated application
50.10(d)(3)(i)	Application to include a safety analysis report in accordance with 10 CFR 52.79, limited to those portions of the facility that are within the scope of the LWA	Applicable to LNP - LNP filed LWA as part of a complete and integrated application and did not limit the safety analysis report to just those portions that are within the scope of the LWA. Design and construction information related to the scope of the LWA is contained in the following FSAR and

Rule Section	Requirement Summary	LNP Compliance in COLA
		AP1000 DCD sections: • 2.5.4.5.1 - Perimeter diaphragm wall • 2.5.4.5.1, 2.5.4.6.2 – Permeation grouting in Avon Park Formation • 2.5.4.2.1.5.2, 2.5.4.5, 2.5.4.12 - Dental Concrete • Table 2.0-201, 2.5.4.2.1.5.2, 2.5.4.5, 2.5.4.8.5, 2.5.4.10, 3.2.1, 3.2.2, Table 3.2-2R - RCC Bridging Mat • Table 2.0-201, 2.5.4.3, 2.5.4.5.4, DCD 3.4.1.1.1.1 – Waterproof membrane and mudmat • 2.5.4.2.1.5.2, 2.5.4.5.2, 2.5.4.7, 2.5.4.8, 2.5.4.10.1.3, 2.5.4.10.3.2, 2.5.4.10.3.3, 2.5.4.10.4.2, 3.7.1.1.2 - Drilled Shafts • DCD 3.8.5 - NI Foundation The placement forms for safety-related concrete are not specifically described in the FSAR or DCD, but are required to be included by the 50.10(a)(1) definition of construction. In addition to the FSAR and DCD descriptions, ITAAC are provided in Part 10 of the COL application for LWA activities: • Part 10, Appendix B, Table 3.8-2, Waterproof Membrane ITAAC • Part 10, Appendix B, Table 3.8-3, RCC ITAAC Other aspects of the LNP site and site characteristics that provide supporting information for the determination of acceptability of the LWA scope of activities are contained in the following sections: • 2.1 – Geography and Demography • 2.2 – Nearby Industrial, Transportation, and Military Facilities • 2.3 - Meteorology • 2.4 – Hydrologic Engineering • 2.5.1 – Basic Geologic and

Rule Section	Requirement Summary	LNP Compliance in COLA
		Seismic Information • 2.5.2 – Vibratory Ground Motion • 2.5.3 – Surface Faulting • 2.5.4.1 – Geologic Features • 2.5.4.2 – Properties of Subsurface Materials • 2.5.4.3 – Foundation Interfaces • 2.5.4.4 - Geophysical Surveys • 2.5.4.5 – Excavations and Backfill • 2.5.4.6 – Groundwater Conditions • 2.5.4.7 – Response of Soil and Rock to Dynamic Loading • 2.5.4.8 – Liquefaction Potential • 2.5.4.9 – Earthquake Site Characteristics • 2.5.4.10 – Static Stability • 2.5.4.11 - Design Criteria • 2.5.4.12 - Techniques to Improve Subsurface Conditions
50.10(d)(3)(ii)	An environmental report in accordance with §51.49	Applicable to LNP – a separate environmental report entitled "Applicant's Environmental Report – Limited Work Authorization Stage" is contained in Part 6, LWA Requests, of the LNP COL application. This report incorporates, in an integrated fashion, information from the Environmental Report submitted as part of the COL application in Part 3.
50.10(d)(3)(iii)	Site Redress Plan	Applicable to LNP – the Site Redress Plan is contained in Part 6, LWA Requests, of the LNP COL application
50.10(e)(1)(i)	LWA: FEIS issuance	N/A – applicable to NRC
50.10(e)(1)(ii)	LWA: presiding officer finding	N/A – applicable to NRC
50.10(e)(1)(iii)	LWA: Director determines applicable standards and requirements of Act, and Commission regulations have been met. The applicant is technically qualified to engage in the activities authorized.	First sentence is N/A – applicable to NRC. Second sentence is applicable to LNP: Technical qualifications (per 52.79(a)(32)) are addressed in Part 1 - General and Financial Information, Subsection 1.1.3; FSAR Section 1.4.1 and 1.4.2.8; FSAR Section 13.1 and Subsection 13.1.3; Part 10 – ITAAC, and proposed License Condition 7 (to be met prior to commencement of LWA construction activities)
50.10(e)(1)(iv)	LWA: no unresolved safety issues	N/A – applicable to NRC
50.10(e)(2)	LWA: specification of activities that holder is authorized to perform	N/A – applicable to NRC
50.10(f)	Risk to applicant of LWA activities performed	Applicable to LNP. The cost exposure of conducting LWA activities without

Rule Section	Requirement Summary	LNP Compliance in COLA
		assurance of NRC issuance of a license exists
50.10(g)	Implementation of redress plan	Applicable to LNP. Implementation of the SRP is required if construction activities are terminated, LWA authorization is revoked, or license application is denied
51.4	Definitions	See discussion under 50.10(a)(1) and 50.10(a)(2), above
51.45(c)	Analysis of impact of preconstruction activities and analysis of cumulative impacts of activities authorized under LWA	Applicable to LNP. Currently, the analysis has addressed preconstruction activities, and cumulative impacts of pre-construction, LWA construction activities, and remaining construction activities after COL issuance. The currently submitted analysis in ER Table 4.8-1 will be modified to distinguish LWA construction activities from COL construction activities, unless the integrated option addressed in 51.49(f), below, is acceptable.
51.49(a)	Submittal of separate environmental report for LWA in addition to environmental report required by 51.50, for LWA submitted as part of complete COL application	Applicable to LNP – a separate environmental report entitled "Applicant's Environmental Report – Limited Work Authorization Stage" is contained in Part 6, LWA Requests, of the LNP COL application. This report incorporates, in an integrated fashion, information from the Environmental Report submitted as part of the COL application in Part 3.
51.49(b)	Phased application	NA to LNP
51.49(c)	LWA request as part of ESP application	NA to LNP
51.49(d)	LWA request by ESP holder	NA to LNP
51.49(e)	LWA for site with EIS but incomplete construction	NA to LNP
51.49(f)	Environmental Report for LWA stage	Applicable to LNP – LNP has currently chosen to integrate information from ER required under 51.50 (Part 3) with information from ER required under 51.49 (Part 6) to arrive at the impacts of construction and operation for the proposed facility (including the environmental impacts attributable to the limited work authorization), and discuss the overall costs and benefits balancing the proposed action.
51.71(e)	Effect of LWA	N/A – applicable to NRC
51.76(a)	LWA: partial or complete FEIS	Applicable to LNP. LNP has requested the NRC to issue a complete FEIS for the project
51.76(b) through (e)	Other LWA requests	NA to LNP
51.76(f)	Draft EIS for LWA	Applicable to LNP for a EIS that

Rule Section	Requirement Summary	LNP Compliance in COLA
		addresses the impacts of construction and operation for the proposed facility, including the environmental impacts attributable to the LWA
51.103(a)(6)	Commission's decision – sunk costs	NA – applicable to NRC
51.104(c)	Hearing proceedings - EIS	N/A – applicable to NRC
51.105(c)(1) through (c)(3)	Hearing proceedings – CPs or ESPs/LWA	NA to LNP
51.107(d)(1) through (d)(4)	Hearing proceedings – COL/LWA	N/A – applicable to NRC
52.1	Definition of LWA	N/A – applicable to NRC
52.17(c)	Issuance of LWA in conjunction with ESP	NA to LNP – no ESP
52.24(c)	ESP shall specify those activities permit holder is authorized to perform	NA to LNP – no ESP
52.27	ESP holder may request a LWA	NA to LNP – no ESP
52.80(b)	Submittal of ER in accordance with 51.49 and 51.50(c) if LWA is requested	Applicable to LNP – ER in accordance with 51.49 for LWA provided in COLA Part 6; ER in accordance with 51.50 for COL provided in Part 3
52.80(c)	Requirement for LWA request before COL issue to include information required by 50.10 and 2.101(a)(1) through (a)(4), or 2.101(a)(9)	Applicable to LNP. LWA request in Part 2, FSAR, Chapter 1, is in accordance with 50.10 and 2.101(a)(1) through (a)(4)
52.91(a)	LWA authorization requirement to perform activities of 50.10(d) – non-ESP	Applicable to LNP. Request for separate authorization made in Part 2, FSAR, Chapter 1
52.91(b)	Implement site redress plan if COL application withdrawn or denied	Applicable to LNP – site redress plan is contained in COLA Part 6
52.99(a)	Requirements for ITAAC schedule with LWA	Applicable to LNP. ITAAC schedule is required to be provided in accordance with regulation
100.23(b)	Investigations in 100.23(c) are not considered "construction"	Applicable to LNP. Investigations were performed and the results described in Part 2, FSAR

ATTACHMENT 2

ADDITIONAL INFORMATION FOR GEOTECHNICAL

This attachment provides revisions to existing information and additional information related to the geology, seismology, and geotechnical engineering design descriptions and safety analyses for the Levy Nuclear Plant (LNP). This information is provided in response to NRC questions in this area of the LNP design and is presented in six sections, as follows:

I. Karst Discussion
II. Roller Compacted Concrete (RCC) Discussion
III. Perimeter Diaphragm Wall Discussion
IV. Permeation Grouting Discussion
V. Site Uniformity Discussion
VI. Heave and Settlement Monitoring Discussion

The information is provided in the form of elaborations on existing information in the indicated subsections of the LNP FSAR or as additional information in the form of new subsections to be incorporated into the FSAR, and will be incorporated into the LNP FSAR in a future update to the COL application.

I. Karst Discussion

The following information will be integrated with the existing information in LNP FSAR Subsection 2.5.4.1.2.1.1:

As discussed in FSAR Subsection 2.5.4.1.2.1, the carbonate rocks of the Avon Park Formation are generally less susceptible to solution activity compared to the Ocala Formation that underlies much of Florida, including the Crystal River Plant (Reference 2.5.1-322). Furthermore, the Avon Park, at the LNP, in the 42.7-m to 57.9-m (140-ft. to 190-ft.) depth interval is less susceptible to karst activity associated with infiltration of surface water than the rock units above this interval. This depth interval within the aquifer is more dolomitized and displays relatively lower porosity characteristics based on geophysical logging. The dissolution process is described in FSAR Section 2.5.4.1.2.1.1.1.

The following text will be incorporated into a new LNP FSAR Subsection 2.5.4.1.2.1.1.1:

The Crystal River 3 FSAR indicates that the Ocala Limestone present at the Crystal River site is dissolving at a rate of 1×10^{-4} percent per year, or 6×10^{-3} percent over 60 years. Due to high levels of dolomitization with recrystallization and the less soluble nature of dolomite than limestone, the Avon Park Formation is less susceptible to dissolution activity and consequential development of karst features than the Ocala Limestone. Given the insignificant rate of annual dissolution activity of the Ocala Limestone at the Crystal River Plant and recognizing that the LNP is founded on the Avon Park, the rate of dissolution activity at LNP is less than 1 x 10^{-4} percent per year.

The following information will be integrated with the existing information in LNP FSAR Subsection 2.5.4.1.2.1.2:

It is noted that the histograms presented in Figure 2.5.4.1-201A and Figure 2.5.4.1-201B are based on the site characterization boreholes, which were largely concentrated in the upper 180 feet. The histogram is based on all of the available data and reflects the fact that there are more data available for the higher portion of the geologic profile simply because, as with all sites, there are more shallow borings and samples than deep borings and samples. Of course, there is a need for more data at shallow depths because the stresses induced by foundations have to be accommodated by the shallower formations, whereas at deeper depths, the induced stresses diminish eventually to nil with depths on the order of 1.5 to 2 times the dimensions of the foundation being supported; hence less data are required at deeper depths. FSAR Subsection 2.5.4.10 demonstrates that potential features located below 180 feet are of considerably less significance given the depth and the robustness of the foundation design, specifically the 35-ft. thick RCC Bridging Mat and the 6-ft. thick AP1000 basemat. The impacts of the subsurface below the upper 180 feet are discussed in regard to bearing capacity, settlement, and other geotechnical parameters in FSAR Subsection 2.5.4.10.

The following information will be integrated with the existing information in LNP FSAR Subsection 2.5.4.1.2.1.3:

In order to determine the design lateral extent of the karst features, a three-part analysis was conducted:

In Part One, the available evidence indicates that existing karst features and future potential features in the Avon Park Formation at the LNP Site are elongated in nature and are associated with vertical or near-vertical fracturing, or the relative competency contrast at bedding planes between horizontal layers.

In Part Two, the typical thickness (vertical dimension) of the existing karst features at the LNP Site was established.

In Part Three, the typical diameter (horizontal dimension or lateral extent) of the existing karst features, as a factor of the vertical dimension, was determined.

Part One (Elongated Nature of Vertical or Horizontal Karst Features):

Vernon (Reference 2.5.3-203) describes a regional fracture set trending NW-SE and NE-SW attributable to the tensional stresses associated with the formation of the Ocala Arch. Evidence has been cited for at least two different episodes of uplift. The first occurred from the Late Oligocene through the early Miocene. The second spanned the early Pliocene through the early Pleistocene.

In March 2008, a subset of these regional fractures was identified during field investigations. This fracture set was observed in local outcrops near the LNP Site during field reconnaissance at the Gulf Hammock Quarry and along the banks of the Waccasassa River. While the trend of these fracture sets is generally consistent on a regional scale, the sets can be discontinuous laterally and vertically.

At the Gulf Hammock Quarry, along an Avon Park Formation outcrop striking due North, primary and orthogonal vertical fractures were observed. Fractures were evident at 30-foot spacing along this outcrop, and had iron staining consistent with water infiltration along the fracture.

Along a portion of the Waccasassa River where the Avon Park Formation outcrops, striking at North 6 degrees West, primary and orthogonal vertical fractures were evident at 35-foot spacing.

Given the strikes of these Avon Park Formation outcrops, and given the observed vertical fractures and spacing, a subset to the regional fracture set was postulated. This local fracture set, with primary fractures consistent with the North 39 degrees West strike associated with Vernon's regional fracture set, features a primary fracture spacing of approximately 19 feet and an orthogonal fracture spacing of approximately 23.5 feet.

The Avon Park Formation outcrop strikes and the postulated fracture pattern associated with each are shown on Figure 2.5.4.1-202.

The linear orientations of the land features in the area appear to be controlled by the two above-mentioned orthogonal joints sets. For example, the Waccasassa River flows in a North 6 degrees West orientation where the aforementioned joints were observed; the Withlacoochee River flows west-northwest. Sections of both the

Waccasassa and Withlacoochee rivers appear to be controlled by the aforementioned rock joints, as the bends are abrupt, and the sections are linear and distinct.

As regards the horizontal solution features, the Upper Floridan aquifer, including the Avon Park Formation at the LNP Site, is a layered aquifer system which produces water along zones near lithological contacts or bedding planes. These contacts are where the horizontal solution features cited above may develop. The local site subsurface conditions also indicate (1) lenses of soft organics that are either thinly layered or dispersed to various degrees among the carbonate layers and (2) weathered and decomposed carbonates that are associated with movement of water from high density vertical fracture zones. These aforementioned layers may provide horizontal pathways for water flow between vertical fractures.

This "plus-sign" morphology, whereby solution activity occurs along orthogonal vertical and horizontal planes (fractures and bedding planes), is consistent with Florida geology. The Avon Park Formation typically exhibits higher degrees of dolomitization than the late Eocene Ocala Limestone, and consequentially, less susceptibility to dissolution activity (Reference 2.5.1-322). Eighteen out of twenty samples of rock that were petrographically analyzed have been completely dolomitized. This is significant because the more dolomitized Avon Park Formation layers have a higher percentage of recrystallized magnesium carbonate, and is therefore less susceptible to the types of karst activity known to occur within the pure calcium carbonate limestone zones typically present within the Ocala Limestone.

Part Two (Thickness / Vertical Dimension):

A review of the subsurface investigation data was conducted to evaluate the potential for karst feature development within the limestone bedrock strata. The features were evaluated based on field observations during the rock coring, such as rod drops and circulation losses, as well as the recovered core and rock quality data (RQD) and relatively low N-values at depth.

The results of this evaluation are presented in Table 2.5.4.2-205A and Table 2.5.4.2-205B. Depth and thickness of each feature are listed and summarized at each plant location and arranged by borehole number. This information is presented graphically on Figure 2.5.4.1-201A and Figure 2.5.4.1-201B, showing histograms of the thicknesses of the observed features. The thicknesses of these features are typically limited to less than 1.5 m (5 ft.).

Part Three (Diameter / Horizontal Dimension):

Three methods were used to estimate the lateral dimension of the karst features on the LNP Site: field observations, geophysical testing, and excess grout takes from the subsurface investigation.

Field Observations

Vertical fractures were evident at the Gulf Hammock Quarry's Avon Park outcrop. The vertical fractures appear to be on the order of 2 to 3 feet wide at the surface and diminishing in width with depth.

Data from the boring logs of the 116 boreholes were evaluated to determine the nature of the karst features. Field observations of rod drops, circulation losses, recovery, and RQD were used to correlate these observations with karst feature geometry.

Geophysical Testing

The gamma-gamma logs indicate randomly distributed low-density zones that have no spatial significance (i.e., two such low-density zones do not occur at the same depth in adjacent boreholes). The low-density zones generally have material present and were not voids or air-filled cavities.

Excess Grout Takes

The total grout intake in gallons at each borehole was recorded or conservatively estimated based on the available data regarding the amount of cement, water, or batches used to grout the boreholes. If no grout data was recorded, there was no grout take calculation for the borehole.

The excess grout was conservatively estimated by assuming that each borehole was only 3.25 inches in diameter (OD of NX rock core), from ground surface to the termination depth. The "excess grout" calculated was the grout that remained after subtracting the volume in the 3.25 inch diameter borehole from the total grout.

For each borehole where grout volumes were indicated in field notes, the following methodology was employed to conservatively estimate the lateral dimension of the most significant feature within the borehole.

1) For calculation purposes, the shape of all features was assumed to be a vertically-aligned cylinder with a horizontal dimension (diameter) being a fraction or a multiple of the vertical dimension, depending on whether the feature is

postulated to occur in a vertical fracture, or along a horizontal bedding plane.

2) The karst features for each borehole were evaluated, and a judgment was made to conservatively consider a "thickness" of the most significant feature within each borehole. The karst feature "thickness" used for each borehole was conservatively minimized, thereby maximizing the lateral dimension (width) of the borehole's vertically-aligned cylinder. The presence of noted "voids" and areas of full circulation loss were factors in the determination of the thickness.

3) A diameter was calculated for the borehole's vertically-aligned cylinder, considering the excess grout volume, and the conservative "height" described in Step 2 above. Based on the height and diameter of the cylinder, it was determined whether the feature would be associated with a vertical fracture or a bedding plane.

4) For features associated with vertical fractures, the excess grout volume was conservatively increased by 50 percent; for features associated with bedding planes, the excess grout volume was conservatively increased by 100 percent.

5) The lateral extent of the most significant feature in each borehole was determined using the cylinder height conservatively estimated in Step 2, and the cylinder volume conservatively estimated in Step 4.

6) The width-to-height ratio of vertical features was determined by dividing the conservatively estimated cylinder diameter by the total thickness of features identified in the borehole.

Anomalies were observed in 29 of the 60 boreholes that were judged to be associated with vertical fractures, with an average lateral extent of 3.1 feet and a maximum lateral extent of 6.1 feet. Anomalies were observed in 31 of the 60 boreholes that were judged to be associated with bedding planes, with an average lateral extent of 6.5 feet and a maximum lateral extent of 9.9 feet.

The average width-to-height ratio of features associated with vertical fractures is 1H:5V, limiting the lateral extent of these features to approximately 20 percent of the vertical extent, as supported by geophysical testing and field observations. Dr. Anthony Randazzo, a subject matter expert, is supportive of the approach that the horizontal dimension is a fraction of the vertical dimension of the feature.

The largest single potential karst feature identified Table 2.5.4.2-205A and Table 2.5.4.2-205B (19.5 feet) would correspond to a vertical feature that is 20 percent of 19.5 feet, or 3.9 feet wide.

If an additional level of conservatism is added by modeling the vertical features as cones instead of cylinders, the postulated lateral extent of the vertical features is increased but is still bounded by the extent of the horizontal features.

Given the conservative estimations made in determining the lateral extent of the postulated karst features at the LNP Site, the RCC Bridging Mat was designed to span a 10-foot diameter void beneath the Bridging Mat (El.-24 ft. NAVD) at any plan location, at any depth.

The following text will be incorporated into a new LNP FSAR Subsection 2.5.4.12.1:

As discussed in FSAR Subsection 2.5.4.1.2.1.1.1, the current dissolution rate of the Avon Park Formation is insignificant with regards to the foundation design. The operation of LNP's production wells, after full installation of the AP1000 basemat, RCC Bridging Mat, and grouted zone, was shown to have little significant impact on the groundwater regime of the site. Compared to the natural regime at the site, the LNP construction was shown to impact the hydrology approximately the same as the seasonal fluctuations. Given this and the very low expected dissolution rates described in FSAR Subsection 2.5.4.1.2.1.1.1, the potential for increased dissolution as a result of construction is also insignificant.

II. Roller Compacted Concrete (RCC) Discussion

The following information will be integrated with the existing information in LNP FSAR Subsection 2.5.4.5.4:

A theoretical rock profile for the North and South Plant Units was developed using LNP site-specific rock properties and layering information. A SAP2000 Finite Element Model (FEM – linearly elastic) of the RCC, nuclear island basemat, and the subsurface rock was created using the design geometry, the rock profile beneath the RCC Bridging Mat, and the total loads applied by the nuclear island.

Also included in the FEM was the presence of theoretical cavities of different sizes and configurations. Three different cases, with cavities located at different depths, were considered:

- Case A: Cavities were located immediately below the grouted limestone, at El. -99 ft. NAVD (75 ft. under the RCC).
- Case B: Cavities were located immediately below the RCC, at El. -24 ft. NAVD.

- Case C: Cavities were located at the top of rock layer NAV-3, which is the layer with lower Elastic Modulus for the North Reactor profile, below El. -149 ft. NAVD (125 ft. under the RCC). This case was analyzed only in the North Reactor, where the lower Elastic Modulus layer is somewhat thicker than in the South Reactor profile.

Examples of the locations of these cavities are shown on Figure 2.5.4.5-204.

Sample stress plots and result tables were generated for the maximum stresses derived from the different cases of this analysis.

The concrete tensile nominal capacity is 230 psi, using the ACI 318-05 equations for structural plain concrete tensile strength. ACI 349 does not include a Chapter for Plain Concrete. No strength factors were used since the nominal capacities are compared with service loads in order to calculate the factors of safety. Unlike reinforced concrete, in which tensile strength is neglected, an allowable tensile strength is permitted for structural plain (unreinforced) concrete, including RCC. A compressive strength of 2,300 psi was considered in this analysis, a conservative reduction from the 2,500 psi design strength. The tensile capacity will be verified with the RCC Test Pad.

The nuclear island vertical load considered in this analysis is 287,000 kips. The total vertical load of 287,000 kips corresponds to an average uniform load of 8.93 ksf, which exceeds the actual DCD Tier 1 requirement for bearing capacity.

In the 3-D FEM, the shear forces were fully transmitted between the basemat and the RCC and between the RCC and the subsurface rock.

In the 3-D FEM, the subsurface material (limestone) that was included in the model below the RCC was sufficiently extended in both lateral direction and depth so that at the borders of the model, the stresses and deformations, due to the external loads applied to the NI basemat, are relatively small.

Any additional strength provided by grouting the upper 75 feet of limestone was conservatively not included in this analysis. The rock mass properties (ungrouted) for that layer were used.

The LNP 2 profile presented lower values of rock mass elastic modulus; therefore, in most cases, the resulting tensile stresses were higher in LNP 2 than in LNP 1.

The following text will be incorporated into a new LNP FSAR Subsection 2.5.4.5.4.1:

A Roller Compacted Concrete (RCC) Test Pad will be constructed much in the same manner as is done for large dams, such as the Saluda Dam. Mix design, material control testing, strength testing, concrete placement, and field testing, including density testing and vebe testing, will be conducted to meet NQA-1 quality requirements.

A suite of mix designs will be established for this concrete, indicating the proportions of material constituents, as well as the target strength. Accelerated curing techniques and subsequent laboratory testing will indicate the preferred mix.

The RCC Test Pad will be constructed to specifications consistent with the design parameters set forth in FSAR Subsection 2.5.4.5.4. The Test Pad will be 50 feet long and 40 feet wide, with two sides consisting of 4H:1V ramps for equipment access, and two sides consisting of vertically formed surfaces. The RCC Test Pad will consist of 6 one-foot vertical lifts.

The ramps associated with this RCC Test Pad will also be constructed to specifications consistent with the design parameters set forth in FSAR Subsection 2.5.4.5.4. The RCC in these ramps will be carefully placed, and will be used to train the constructors and equipment operators on the proper mixing and placement techniques for RCC.

As stockpiles of the materials are built, moisture tests and gradation analyses will be performed on an as-needed basis. The specific gravity of each material will also be verified. While the Test Pad is constructed, moisture testing will occur, and 24 test specimens will be gathered for each lift of material. These specimens will be tested for compression, modulus of elasticity, and split tensile strength. Bedding materials used will also be tested for compressive strength. Three holes will be drilled in the Pad to determine shear wave velocity properties of the material using crosshole logging techniques. These Testing Services will provide strength properties and in-place shear wave velocities, ensuring that target property requirements will be met.

The tests will also establish the placement techniques that will be directly applicable during AP1000 foundation construction. The RCC Test Program will provide pertinent information for the RCC Bridging Mat construction.

After the Test Section is constructed, long term (>30 days) compression tests will be performed and shear resistance will be measured at lift lines.

The following information will be integrated with the existing information in LNP FSAR Subsection 2.5.4.12:

Subsequent to the excavation described in FSAR Subsection 2.5.4.5.3, a RCC Bridging Mat will be constructed at El.-24 ft. The mat will be installed in one-foot lifts to El. 11 ft.

The RCC will be mixed on-site and a Creter Crane (or similar machine) will place materials delivered from the mixing plant. The delivered RCC will be spread with dozers to a compacted lift thickness of 1 foot. At least four passes of smooth drum vibratory rollers will be used to compact the RCC. A mix design program and full-scale test section is planned, as described in FSAR Subsection 2.5.4.5.4.1.

During the construction of the RCC Bridging Mat, field measurements of RCC density will be performed using a "single-probe nuclear densometer" for each 1-ft. lift during placement of the RCC.

Verification laboratory tests will be performed to confirm that the compressive strength of the RCC is satisfactory. The tests will be conducted using six cylindrical test specimens molded during construction, in accordance with ASTM C 1435/C 1434M-05: "Standard Practice for Molding Roller-Compacted Concrete in Cylinder Molds Using a Vibrating Hammer". Concrete to make the test specimens will be taken from six different locations for each 1-ft. lift of the RCC. Three samples will be taken at each of the six locations. The compressive strength tests will be conducted within 1 year of placement of the RCC. Compressive strength testing will be performed in accordance with ASTM C 39 "Test Method for Compressive Strength of Cylindrical Concrete Specimens." All laboratory testing will conform to NQA-1 quality requirements. The strength level of RCC, adjusted for aging, will be considered satisfactory if either conditions 1 and 2 or conditions 1 and 3 are satisfied:

1) The average of compressive strength from three cylinders molded at a location equals or exceeds f'c.

2) No individual strength test (average of two cylinders) falls below f'c by more than 500 psi.

3) If individual strength tests (average of two cylinders), adjusted for aging, fall below f'c by more than 500 psi, a minimum of three cores drilled from the area in question shall be tested. The cores shall be drilled in accordance with ASTM C42: "Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete." RCC in areas represented by core tests shall be considered

adequate if the average of compressive strength from three cores is equal to at least 85 percent of f'c and if no individual core compressive strength is less than 75 percent of f'c.

If these acceptance criteria are not met, an evaluation of the acceptability of the RCC for its intended function shall be performed before acceptance.

III. Perimeter Diaphragm Wall Discussion

The following text will be incorporated into a new LNP FSAR Subsection 2.5.4.5.1.1:

A diaphragm wall with prestressed tiebacks will be used as a groundwater cutoff and excavation support system to facilitate the 67-foot deep excavation. The analysis includes an assessment of the required diaphragm wall thickness and reinforcement, the arrangement and required number of anchors, the maximum expected anchor load for each construction stage, and the required bonding length of each anchor.

A diaphragm wall system with prestressed tiebacks is planned to enable the excavation and dewatering of the nuclear island. This continuous wall is designed as an excavation support system to facilitate the 67-foot-deep excavation and prevent excessive groundwater from entering the excavation area.

The diaphragm wall with tiebacks was considered to be a stiff wall system, and construction-sequencing analysis using classical soil pressures was employed for the design.

An earth pressure diagram for a rigid wall (with a fixed base) consists of an apparent earth pressure on the upper section of the wall and a triangular distribution on the lower section of the wall. The earth pressures are based on the at-rest lateral earth pressure condition.

SAP2000 was used to analyze moment and shear force distribution of the continuous beam. For the reinforced concrete component design, the ACI 318 Ultimate Strength Design (USD) method was used.

As a design input, the groundwater level is assumed to be at ground surface behind the diaphragm wall, and 5 feet below the excavation in front of the wall; i.e., the excavation is dewatered and there is no water pressure in front of the diaphragm wall during each stage of construction. Full hydrostatic pressure was considered behind the wall.

For each stage of construction, two feet of over-excavation is considered below an anchor location. The bonding strength between grout and limestone rock is interpreted to be 200 psi (1.4 Mpa) based on published data.

The inclination of the anchors is 45 degrees, and all anchors will be keyed into competent rock. The drilled anchor holes are 6 inches in diameter.

The compressive strength of concrete is 4,000 psi, and the elastic modulus of concrete 3,000 ksi, calculated based on the concrete compressive strength.

The diaphragm wall includes 7 rows of prestressed anchors. To reduce the shear force and moment imposed on the wall by the earth pressure, anchors are closely spaced at the lower section of the wall, and relatively widely spaced at the upper section. The construction sequencing analysis involved 8 stages of analysis, each stage considering an over-excavation of 2 feet below the anchor location.

For the structure component design, ACI 318 Ultimate Strength Design (USD) methodology was used and a load factor of 1.2 was used for the design; allowable strength design (ASD) methodology was used for the anchor design, and a factor safety of 2.0 is used to determine the bonding length.

The concrete compressive strength is to be 4,000 psi. The minimum required wall thickness is 3.5 feet, and the reinforcement ratio is to be 1 percent, reinforced on both sides (2 percent total). The embedment into rock is to El. -54 feet NAVD.

The spacing of the 7 rows of prestressed anchors is shown on Figure 2.5.4.5-203. Figure 2.5.4.5-203 shows the required bonding lengths of each anchor, as well as maximum tieback force in each anchor. The anchors will be inclined at 45 degrees and bonded into the limestone of the Avon Park Formation. The prestressed anchors will be placed at 10 ft. (3 m) spacing around the entire perimeter of each diaphragm wall.

The following text will be incorporated into a new LNP FSAR Subsection 2.5.4.5.1.1.1:

In order to support the excavation of the nuclear islands, reinforced diaphragm walls will be constructed as the boundary of the excavation limits. These excavation limits are discussed in Section 2.5.4.5.2 and are shown on Figures 2.5.4.5-201A, 2.5.4.5-201B, 2.5.4.5-202A, and 2.5.4.5-202B.

These diaphragm walls will be installed, prior to excavation, from the existing ground surface ranging from El. 12.8 to 13.1 m (42 to 43 ft. NAVD) at LNP 1, and 12.5 to 13.1

m (41 to 43 ft. NAVD) at LNP 2. The diaphragm walls will serve as an excavation support system to facilitate excavation to El. -7.3 m (-24 ft. NAVD), and will extend in depth to El. -16.5 m (-54 ft. NAVD) to support construction dewatering, as discussed in Section 2.5.4.6.2. Constructed approximately 9.1 m (30 ft.) into competent limestone, the diaphragm walls will be advanced using a kelly-mounted Hydrofraise excavator, standard practice for the installation of such walls.

IV. Permeation Grouting Discussion

The following text will be incorporated into a new LNP FSAR Subsection 2.5.4.5.1.2:

Due to the high groundwater table and the documented permeability of the Avon Park Formation beneath the site, the upper 75 feet of the Avon Park Formation will be grouted to diminish its porosity and permeability. The grouting will allow the excavation to be made in a safe and predictable manner by minimizing the upward flow of groundwater into the excavation and to aid in the resistance to uplift pressures on the excavation bottom. An uplift analysis indicated sufficient reduction of shear stresses in the grouted rock, and the computed factor of safety exceeded 1.5.

The grouting is non safety related. However, diminishing the porosity and reducing the permeability will have the beneficial effect of impeding flow through the uppermost Avon Park Formation and, therefore, minimize the potential for the initiation and/or growth of solution activity.

Although this will be an added benefit, the increase in compressive and shear strength of the Avon Park Formation has not been considered in other analyses. Bearing capacity, settlement, and site response were assessed on the basis of properties of the Avon Park Formation as measured during the site characterization program without grouting. The success of the Grout Program will be determined by the lack of groundwater intrusion during the excavation dewatering and not the increase in density, stiffness, or strength of the Avon Park Formation.

As a design input for the determination of the grouted zone, the groundwater is conservatively considered to be at the existing ground surface (between El.42 ft. and El.43 ft. NAVD).

As part of the construction dewatering effort, a zone beneath each proposed nuclear island will be grouted in order to achieve the following three goals:

1) Form a "bottom of the bathtub" to prevent the flow of groundwater up through the bottom of the excavation.

2) Protect the excavation base from heaving.

3) Inhibit the flow of water through porous zones in this zone beneath each nuclear island, thereby reducing the future potential for solution activity.

The top elevation of the grouted zone (El.-24 ft. NAVD) was based on the top of rock and defines the elevation which the RCC Bridging Mat will be founded on. The proposed thickness of this grouted zone (75 ft., to El.-99 ft. NAVD) was determined based on the review of site data and discussions with site geologists. For example, shear wave velocity measurements from Borings A7, I2, AD1, A8, and I3, indicate a shelf within the Avon Park Formation at approximate El.-97 feet NAVD under the North Reactor LNP 2, where shear wave velocity increases from approximately 3,500 feet per second to approximately 5,000 feet per second. Boring Logs from Borings A7, A8, A9, and A10 indicate that the Avon Park Formation, in general, becomes less weathered, has a higher recovery, and higher RQD below El.-97 NAVD.

A similar shelf exists under the South Reactor LNP 1 at approximately -180 feet. However, Boring Logs from Borings A14, A17, A19, and A20 indicate that the Avon Park limestone, in general, has a higher recovery and higher RQD below El.-97 ft. Additionally, geophysical logs from A-19 and A-20 indicate a higher shear wave velocity below El.-97 ft. NAVD. Based on the above information, El.-99 ft. NAVD has been designated as the bottom of the grouted zone resulting in a relatively large, 75 foot thick zone. As discussed in FSAR Subsection 2.5.4.1.2.1.1, this shelf extends at least 50 feet in depth and is characterized as a lower-porosity zone.

Grouting the entire 75-foot zone between the RCC Bridging Mat and the Avon Park Formation will accomplish goals one (1), two (2), and three (3) listed above. As previously noted, no credit was taken for this grout increasing the strength or stiffness of the grouted zone.

The grout will be bounded horizontally by the diaphragm wall between the bottom of the RCC Bridging Mat (El.-24 ft. NAVD) and bottom of the diaphragm wall (El.-54 ft. NAVD). From this elevation to the bottom of the grouted zone (El.-99 ft. NAVD), the grouted zone will be bounded by a grout curtain.

The Grout Program will be accomplished in two phases. Prior to the excavation of the nuclear island foundations, grout holes will be drilled from the existing ground surface to the proposed bottom of the target grouted zone (approximately 150 feet below ground surface). The first phase will consist of drilling and grouting on eight-foot center-to-center spacing with a relatively low mobility grout (LMG). This LMG helps to form a perimeter to contain the second phase of grouting. The LMG grouting includes the installation of the grout curtain below the diaphragm wall. The purpose of the grout curtain is to "extend" the diaphragm wall and form a border around the grouted zone. A high mobility grout (HMG) will be drilled and grouted on split-spacing between the LMG holes. The HMG will fill in the area defined by the LMG. This is considered the second phase of the Grout Program.

State-of-the-practice computerized monitoring of all grouting will take place, including the measurement of grout take in terms of pressure and volume. A field test will be conducted prior to construction of this grouted zone to establish appropriate mixes for both the LMG and HMG and to confirm that the grout hole spacing is adequate. The eight-foot grout hole spacing is currently based on experience in the industry. It is noted as a good starting point to be refined with a field test prior to and during construction.

The following text will be incorporated into a new LNP FSAR Subsection 2.5.4.5.1.2.2:

A Grout Test Program is in the planning stages and is expected to be implemented within the next year. Though grouting is not safety-related, mix design, material control, laboratory testing, grout placement, and field testing will be conducted to meet NQA-1 quality requirements.

Mix designs will be established for the various grout types, indicating the proportions of material constituents, as well as the target design parameters. All grout mixes will be a combination of water, cement, flyash, bentonite, and superplasticizer. Mortar grout mixes or "low mobility sand grout mixes" will not be used.

A Grout Test will be implemented to specifications consistent with the design parameters set forth in this FSAR. The Grout Test Program will consist of nineteen grout holes arranged in a hexagonal pattern, including seven "Primary" grout holes of a higher viscosity grout, and twelve "Secondary" grout holes of a lower viscosity grout. These nineteen holes will be upstage grouted from a depth of 141 feet below ground surface (bgs) to a depth of 66 feet bgs, as prescribed for the large-scale foundation grouting effort.

The purpose of the Grout Test Program is to validate the grout design and grouting techniques, to measure the change in the shear wave velocity and permeability of the grouted zone, and to determine the grout take in the Avon Park Formation. The work will include the drilling and installing of Tube-a-Manchette (TAM) pipes in the nineteen grout holes, and subsequent water testing and grouting in each TAM, isolating valves every three feet. A GIN curve and target permeability (in Lugeons) will be used to dictate target grout pressures/volumes.

In the event that it is not practical to fracture the grout surrounding the TAM's, with the associated implication that the surrounding rock is competent, the TAM's will be dropped from the program, and double packers will be used directly against the walls of the grout holes.

The grout holes will be installed using an automated real-time monitoring system for the water pressure testing and grouting, capable of computing a suite of engineering data allowing side-by-side evaluation of geology, grout mixes, Lugeon values and apparent Lugeon values, and plotting data into reports and CADD drawings.

Six initial and final verification core holes will be drilled and water tested to verify pre- and post-test conditions. Upon completion of the Grout Program, P-S suspension logging will be performed to determine the increase in stiffness of the grouted mass. This suspension logging will show whether significant stiffening of the subsurface has occurred, thereby resulting in potential impacts to the site response analysis. It is expected that the increased stiffness of the grouted zone will still be bounded by the randomization used in the site response analysis, as discussed in FSAR Subsection 2.5.2.5.1.

The following text will be incorporated into a new LNP FSAR Subsection 2.5.4.5.1.2.1:

The grouting operation will be conducted from, at or near, the existing ground surface by drilling boreholes from the surface down to the approximate El. of -30.2 m (-99 ft.) NAVD, and setting casing (either perforated or "tube-a-manchette" – a rubber sleeve between two packers). While uncased holes would be preferred, the existing site characterization data suggest that the holes may cave before they can be grouted; therefore, casing will be specified. The top elevation of the grouted zone will be at El. -7.3 m (-24 ft.) NAVD, resulting in a 22.9 m (75 ft.) thick grouted zone.

Grouting will generally be performed by the upstage method with pneumatic packers and a combination of lower mobility grout (LMG) and high mobility grout (HMG) to be established with a Grout Test Program prior to the commencement of the grouting program, as discussed in FSAR Subsection 2.5.4.5.1.2.2. Grout holes are initially spaced to achieve "no take" conditions. Hole spacing, grouting pressures, and acceptable grout takes will be established with the Grout Test Program. Grouting is non safety-related, however it will be performed under a quality program.

A GIN curve and target permeability (in Lugeons) will be used to dictate target grout pressures/volumes. The grout holes will be installed using an automated real-time monitoring system for water pressure testing and grouting, capable of computing a suite of engineering data allowing side-by-side evaluation of geology, grout mixes, Lugeon values and apparent Lugeon values, and plotting data into reports and CADD drawings.

V. Site Uniformity Discussion

The following information will be integrated with the existing information in LNP FSAR Subsection 2.5.4.10.1.1 (a reference to this subsection will be added to the existing LNP FSAR Subsection 2.5.4.2.1.1.2):

Rock mass properties and compressive strength values from the North and South Reactor Avon Park Formation Profiles were used to calculate the bearing capacity of the RCC and subsurface limestone formation. These rock profiles included the lower-strength zones located below El. -180 ft. NAVD for LNP 1 and below El. -150 ft. NAVD for LNP 2. Bearing capacity results were compared with the static and dynamic allowable load bearing pressures.

The subsurface at LNP consists of limestone formations that extend to a depth of more than 450 feet below plant grade, beneath 67 feet of undifferentiated Quaternary and Tertiary sediments. Beneath the nuclear island basemat, the undifferentiated sediments will be replaced by a 35-foot thick RCC Bridging Mat. Seventy-five feet of limestone beneath the RCC will be grouted for dewatering purposes.

A nominal rock profile was developed which considered plant site-specific rock properties.

The bearing capacity of the RCC Bridging Mat was calculated using the ACI 318-89 permissible service load stresses on concrete. The bearing capacity of the subsurface limestone formation was calculated using two different methods: a simplified AASHTO formulation for footings on broken or jointed rock; and the U.S. Army Corps of Engineers (USACE) formulation for two different failure modes of rock subsurface, considering both static and dynamic loads.

The shear strength of the subsurface limestone formation, based on the rock mass strength parameters (cohesion and friction angle) was compared to the shear stresses calculated with a Finite Element Model.

The factors of safety comparing the bearing capacity of the RCC with the subsurface limestone formation were calculated using static and dynamic allowable bearing pressures.

The gross bearing pressures to be imposed on the RCC are 8.6 ksf for static loading and 35.0 ksf for dynamic loading. These values were developed, in the dynamic case, for the safe shutdown earthquake (SSE) of 0.3g (PGA) on soft soil conditions. The dynamic allowable bearing pressure corresponds to the maximum subgrade pressure at the basemat that results from a time-history analysis on soft soil. For the subsurface rock bearing capacity calculations, the RCC self weight was included as an additional bearing pressure load of 5.16 ksf. The buoyancy effects due to the hydrostatic pressure acting at the bottom of the RCC were considered in this analysis. For conservative buoyancy effects, the water table was considered to be at El. 38 ft. NAVD.

The compressive strength of the RCC was considered to be 2,300 psi, a conservative reduction from the design strength of 2,500 psi, which is considered to occur after one year of the concrete placement.

The dynamic forces and moments at the basemat that were used in this analysis to estimate the dynamic eccentricities of the North and South Reactors correspond to the maximum seismic reactions at the center line of the Containment Building that result from a time-history analysis.

The factors of safety for static and dynamic loading of the RCC are above the minimum requirements, and the RCC bearing capacity is adequate to accommodate the static and dynamic pressures that were considered in this analysis. The estimated factors of safety resulted in 11.6 for static loading and 2.8 for dynamic loading. Note that the dynamic loads are based on a 0.3g modified RG 1.60 SSE. The site specific SSE is less than 0.1g. Thus, the actual factor of safety for dynamic loading is significantly higher than the calculated factor of safety of 2.8. The calculated factors of safety are significantly larger than the acceptable factors of safety of 3.0 for static loading and 2.0 for dynamic loading.

The incremental shear stresses induced at or below El.-150 ft. NAVD (where a lower-strength zone exists) were found to be less than 2 psi (less than 25 percent of the incremental shear stress induced at the nuclear island basemat). For this reason, characterization of the subsurface conditions below El.-150 ft. NAVD was determined to be adequate.

The following information will be integrated with the existing information in LNP FSAR Subsection 2.5.4.10.3.1:

The elastic settlements of the subsurface, due to the weight of the RCC and the total construction loads applied to the nuclear island, were calculated.

The subsurface at LNP consists of limestone formations that extend to a depth of more than 450 feet below plant grade, beneath 67 feet of undifferentiated Quaternary and Tertiary sediments. Beneath the nuclear island basemat, the undifferentiated sediments will be replaced by a 35-foot thick RCC Bridging Mat. The upper 75 feet of limestone will be grouted for dewatering purposes.

Nominal rock profiles were developed for both the North and South Plant Units using LNP site-specific rock properties and layering information. These rock profiles included the lower-strength zones located below El.-180 ft. NAVD for LNP 1 and below El.-150 ft. NAVD for LNP 2. A SAP2000 elastic Finite Element Model of the RCC, nuclear island basemat, and the subsurface rock was developed using the design geometry, the rock profile configuration beneath the RCC, and the total loads applied on the nuclear island.

Settlements of the RCC Bridging Mat were calculated using the FEM. Two cases were analyzed: Case A: Settlements correspond to El. -24 ft. NAVD (bottom of RCC); and Case B: Settlements correspond to El. 11 ft. NAVD (top of RCC).

The elastic settlement results of the FEM Case A were compared with the results from two analytical procedures.

- Elastic settlement calculation using the subgrade modulus at three different locations: center, border midpoint, and corner of the RCC Bridging Mat.
- The elasticity deformation theory, considering a constrained rock mass elastic modulus and the Boussinesq solution for vertical stress distribution.

The average settlements predicted by the FEM analysis were in agreement with the results of the two alternative analytical procedures. For the FEM analysis, the average settlement at El. -24 ft. NAVD (bottom of RCC) resulted in approximately 0.21 inches at the North Reactor and 0.18 inches at the South Reactor.

The differences in settlements predicted by the FEM and by the analytical methods are negligible. The analytical equations consistently lead to slightly lower settlement values.

In Case B of the FEM analysis, settlement results at El. 11 ft. NAVD (top of RCC) are reported in order to assess RCC deformation due to the applied loads. The average difference between values at this elevation and at El. -24 ft. NAVD is approximately 0.01 inches.

Given the small incremental shear stresses being induced below El.-150 ft. NAVD, as well as the small predicted settlement values, the characterization of the subsurface below El.-150 ft. NAVD (approximately 200 feet below final plant grade) performed was determined to be adequate.

VI. Heave and Settlement Monitoring Discussion

The following information will be integrated with the existing information in LNP FSAR Subsection 2.5.4.10.3.5 (a reference to this subsection will be added to the existing LNP FSAR Subsection 2.5.4.6.2):

A monitoring program will be implemented during construction to monitor settlement and heave with two primary elements; water pressure monitoring and settlement (heave) monitoring.

With respect to water pressures, we plan the following:

- Monitoring the head outside the perimeter of the diaphragm wall with 10 piezometers (open standpipes) installed to El. -24ft. NAVD
- Monitoring the head with piezometers (a) within the excavation at El. 0 ft. NAVD (~2/3 depth of excavation) with 6 piezometers (b) at El. -29 ft. NAVD (5 ft. below the bottom of the excavation) with 6 piezometers and (c) at El. -99 ft. NAVD (immediately below the grouted zone) with 3 piezometers.
- Settlement monuments, currently expected to be telltales at El. -24 ft. NAVD to monitor heave and settlement as the excavation proceeds.
- Settlement bench marks will be installed within the subgrade mudmat (at approximate El. 3.4 m [11 ft.] NAVD) at the four corners of each nuclear island and at the (plant) northernmost point of each containment building. These will be

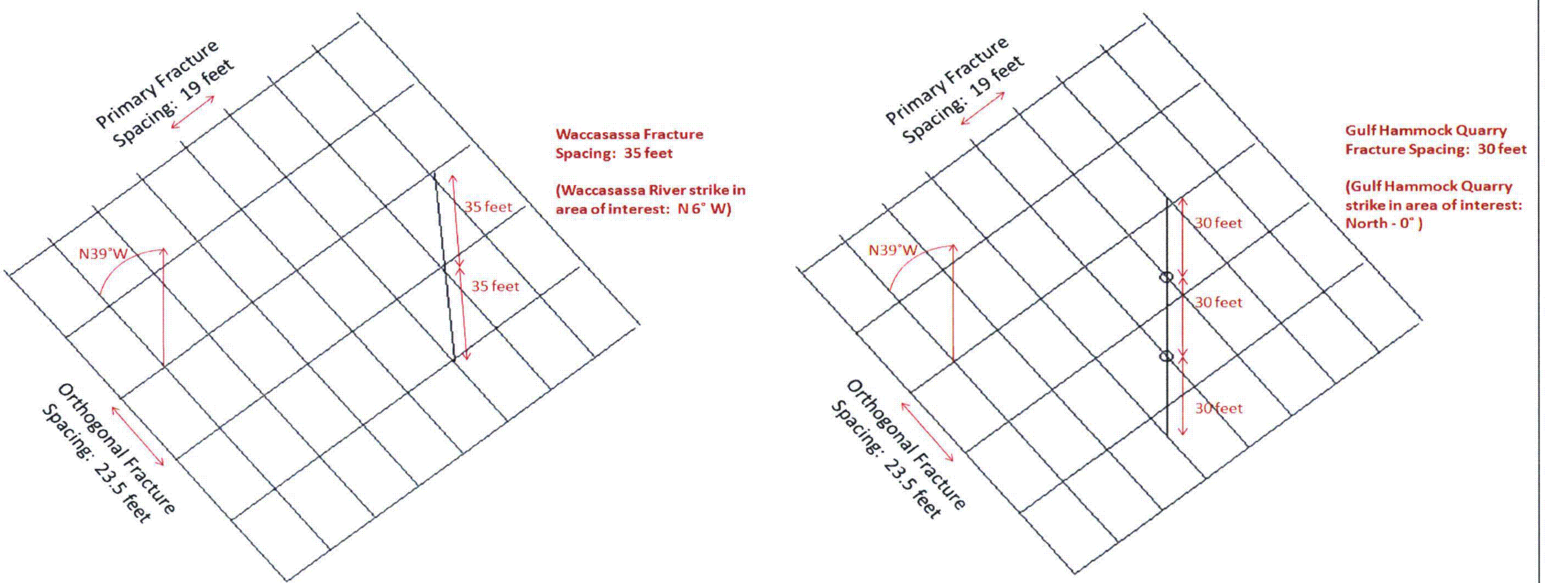
monitored before and periodically during construction of the nuclear island basemat and sidewalls prior to placement of backfill materials.

- Additional bench marks will be installed approximately 1 meter (3 feet) above site grade (at approximate El. 16.5 m [54 ft.] NAVD) and connected to the sidewalls of the nuclear island, directly above the deeper bench mark locations described previously. These bench marks will be monitored during backfilling operations and, periodically, during and after construction of the nuclear island structures.

Monitoring will be continued until at least 90 percent of expected settlement has occurred or the rate of settlement has virtually stopped. This will be evaluated by review of the settlement versus time curves at the bench mark locations.

The following information will be integrated with the existing information in LNP FSAR Subsection 2.5.4.10.3.5:

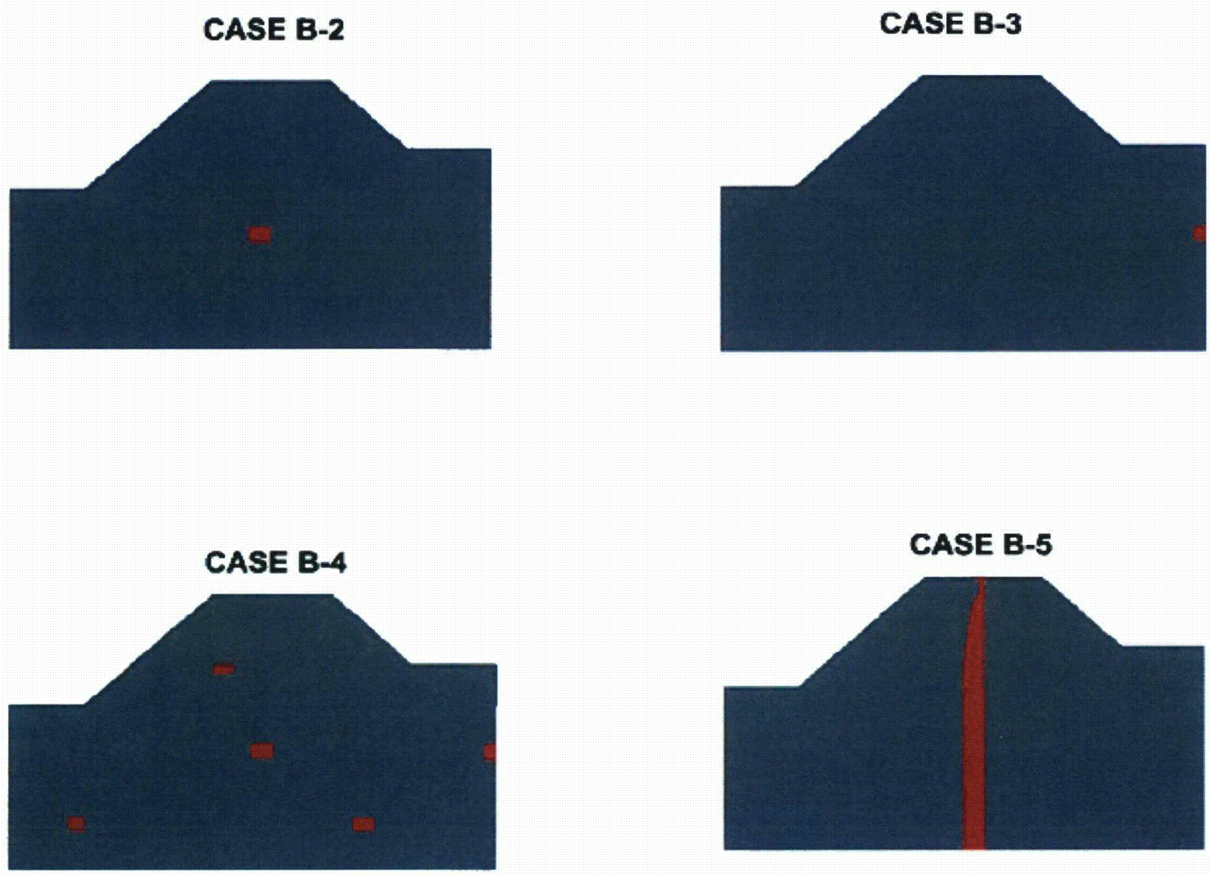
A monitoring program will be implemented after construction to monitor any long-term settlement. While long-term settlement is expected to be minimal, the settlement bench marks installed during the construction phase (connected to the sidewalls of the nuclear islands) will be used post-construction to monitor settlement of the nuclear island structures.



Progress Energy Florida
Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

Primary and Orthogonal Fracture Pattern
Local Avon Park Formation Outcrops
Figure 2.5.4.1-202

Rev 0



Note:
This Figure presents a conceptual design that was developed for COL Application. Detailed design will be completed prior to construction, and the dimensions and quantities shown herein are subject to change at that time.

Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

RCC Elastic Stress Analysis
Example Cases for Cavity Placement
Figure 2.5.4.5-204

Rev 0

ATTACHMENT 3

CITRUS AND LEVY COUNTY RADIOLOGICAL EMERGENCY PLANS

PROGRESS ENERGY LNP COLA – CITRUS & LEVY REP PLANS
PRE-FLIGHT REPORT

This document serves as a pre-flight report for the Citrus and Levy County Radiological Emergency Preparedness (REP) plans, submitted as supplemental information to the Levy Nuclear Plant COL Application. The following files do not pass pre-flight with the error being "resolution lower than 300 pixels per inch". Based on past submittals, it is understood that this error is acceptable due to embedded images in the native versions of the files, prior to the distilling step. These files have been prepared in compliance with NRC electronic submittal guidance.

No.	File Name	Preflight Status	Reason
1	Citrus County REP Plan.pdf	Error/Failed	< 300 ppi - (due to embedded images in native file)
2	Levy County REP Plan.pdf	Error/Failed	< 300 ppi - (due to embedded images in native file)