FPL.

L-2015-183
10 CFR 52.3

July 13, 2015

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

Re: Florida Power & Light Company
Proposed Turkey Point Units 6 and 7
Docket Nos. 52-040 and 52-041
Voluntary Revised Response to NRC Request for Additional Information Letter No. 082 (eRAI 7811) – Standard Review Plan Section 02.05.04 – Stability of Subsurface Materials and Foundations

References:

1. NRC Letter to FPL dated February 18, 2015, Request for Additional Information Letter No. 082 (eRAI 7811) Related to SRP Section 02.05.04 – Stability of Subsurface Materials and Foundations for the Turkey Point Nuclear Plant Units 6 and 7 Combined License Application
2. FPL Letter L-2015-116 to NRC dated April 10, 2015, Response to NRC Request for Additional Information Letter No. 082 (eRAI 7811) SRP Section 02.05.04 – Stability of Subsurface Materials and Foundations
3. FPL Letter L-2015-127 to NRC dated April 17, 2015, Response to NRC Request for Additional Information Letter No. 082 (eRAI 7811) SRP Section 02.05.04 – Stability of Subsurface Materials and Foundations
4. FPL Letter L-2015-130 to NRC dated April 27, 2015, Response to NRC Request for Additional Information Letter No. 082 (eRAI 7811) SRP Section 02.05.04 – Stability of Subsurface Materials and Foundations

FPL and NRC Staff have been engaged in interactions with respect to the information provided in References 2, 3, and 4 in response to the NRC Requests for Additional Information (RAIs) provided in Reference 1.

As a result of these interactions, Florida Power & Light Company (FPL) is providing, as attachments to this letter, revised responses for the Nuclear Regulatory Commission's (NRC) Requests for Additional Information (RAI) RAI 02.05.04-31 provided in Reference 2, RAI 02.05.04-32 provided in Reference 3, and RAI 02.05.04-33 provided in Reference 4. Changes are identified by revision bars. The attachments identify changes that will be made in a future revision of the Turkey Point Units 6 and 7 Combined License Application (if applicable).

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NRO

If you have any questions, or need additional information, please contact me at 561-691-7490.

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

Executed on July 13, 2015.

Sincerely,

William Maher
Senior Licensing Director – New Nuclear Projects

WDM/RFB

Attachment 1: FPL Revised Response to NRC RAI No. 02.05.04-31 (eRAI 7811)
Attachment 2: FPL Revised Response to NRC RAI No. 02.05.04-32 (eRAI 7811)
Attachment 3: FPL Revised Response to NRC RAI No. 02.05.04-33 (eRAI 7811)

cc:
PTN 6 & 7 Project Manager, AP1000 Projects Branch 1, USNRC DNRL/NRO
Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant 3 & 4

NRC RAI Letter No. PTN-RAI-LTR-040

SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations

QUESTIONS from Geosciences and Geotechnical Engineering Branch 1 (RGS1)

NRC RAI Number: 02.05.04-31 (eRAI 7811)

In response to RAI 02.05.04-12(d), the applicant indicated that the sulfate measured from groundwater samples classify the concrete exposure to sulfate attack as severe based on ACI, and proposed to make the first lift of concrete fill (bottom lift) from sulfate resisting Type V cement with maximum C3A content of 5 percent as specified in ACI 318-05/318R-05 to address the issue of concrete fill exposure to sulfate attack from groundwater. However, in additional to cement type, ACI 318-05/318R-05 also specify the maximum water-cementitious material ratio and minimum concrete strength for concrete to resist sulfate attacking. In accordance with 10 CFR 100.23, please specify what water-cementitious material ratio and concrete strength are to be used for the first lift of concrete fill, and provide corresponding updates into the FSAR to reflect the evaluation and prevention of groundwater chemicals attacking concrete fill.

FPL RESPONSE:

This response provides an update to the Response to RAI 02.05.04-12(d). The only update to the RAI 02.05.04-12(d) response is the commitment to ACI 201.2R-08 instead of ACI 318-05/318R-05 for durability requirements, since the latter is more of a design code for reinforced concrete, and the former is actually guidance on the durability of concrete in general, which is the intended use.

The sulfate values measured from 24-water samples range from 2280 ppm to 4400 ppm, resulting in a median value of about 3800 ppm, or close to 0.4 percent by weight. This classifies the concrete exposure to sulfate attack as Class 2 exposure according to the ACI Guide to Durable Concrete, ACI 201.2R-08 (Reference 1).

Recommendations for improving sulfate resistance are provided in the ACI Guide to Durable Concrete, ACI 201.2R-08 (Reference 1). Reference 1 provides recommendations for the maximum water-cementitious material ratio and type of cement for various degrees of potential sulfate exposure; Reference 1 does not provide recommendations for minimum concrete strength. For the first lift of concrete (bottom lift), the requirements in Table 6.3 of Reference 1 for water-cementitious material ratio and type of cementitious materials will be followed in order to provide resistance to sulfate attack. The minimum thickness of the first lift of concrete is 2.5 feet. The concrete mix for the first lift will contain a maximum water-cementitious material ratio by mass of 0.45, and a sulfate resisting Type V cement or equivalent as defined in Sections 6.2.5, 6.2.7, and 6.2.9 of the ACI Guide to Durable Concrete, ACI 201.2R-08 (Reference 1). In addition, Type V cement or equivalent according to ACI 201.2R-08 (Reference 1) will be used for all the lifts for additional protection. Delivery tickets will be prepared according to ACI 311.5 (Reference 2) and inspected to ensure that the water-cementitious material ratio and the type of cementitious materials for the first lift meet durability requirements in ACI 201.2R-08 (Reference 1) for Class 2 sulfate exposure.

Additional details regarding the design and construction approach for the concrete fill will be provided in the Response to RAI 03.08.05-03.

The Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) that will be used to ensure that the first lift of concrete fill meets the ACI 201.2R-08 durability requirements are provided in Table 1. The ITAAC that will be used to ensure that the concrete fill meets specifications in ACI 207 (FSAR Reference 2.5.4-281) are provided in the Response to RAI 02.05.04-33.

Table 1
ITAAC for Concrete Fill under Seismic Category I Structures

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
First lift of concrete fill placed under the nuclear island basemat, containment building, shield building, and auxiliary building, meets durability requirements of ACI 201.2R-08, Table 6.3 for Class 2 sulfate exposure.	Delivery tickets will be prepared according to ACI 311.5 and inspected to ensure that the first lift of concrete fill (minimum thickness of 2.5 feet) meets durability requirements of ACI 201.2R-08, Table 6.3 for Class 2 sulfate exposure.	The first lift of concrete fill (minimum thickness of 2.5 feet) meets durability requirements of ACI 201.2R-08, Table 6.3 for Class 2 sulfate exposure.

References:

1. American Concrete Institute, *Guide to Durable Concrete* (ACI 201.2R-08), 2008.
2. American Concrete Institute, *Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete* (ACI 311.5-04), 2004.

ASSOCIATED COLA REVISIONS:

A new paragraph after the third paragraph in the FSAR Subsection 2.5.4.5.1.2 will be added in a future COLA revision as follows:

2.5.4.5.1.2 Power Block and Site Grade Raising

Structural fill consisting of excavated fill material is placed around but not below any nuclear island structure. Replacement material below the nuclear islands consists of ~~lean~~ concrete fill. The selection of ~~lean~~ concrete **fill** mix design is made at project detailed design. The compressive strength of 1.5 ksi is estimated for ~~lean~~ concrete fill.

The concrete fill exposure to sulfate attack from groundwater is classified as Class 2 exposure according to Reference 323. Recommendations for improving sulfate resistance are provided in the ACI Guide to Durable Concrete, ACI 201.2R-08 (Reference 323). For the first lift of concrete fill (bottom lift), the requirements in Table 6.3 of Reference 323 for water-cementitious material ratio and type of

cementitious materials are followed in order to provide resistance to sulfate attack. The minimum thickness of the first lift of concrete fill is 2.5 feet. The concrete mix for the first lift contains a maximum water-cementitious material ratio by mass of 0.45, and a sulfate resisting Type V cement or equivalent as defined in Sections 6.2.5, 6.2.7, and 6.2.9 of the ACI Guide to Durable Concrete, ACI 201.2R-08 (Reference 323). In addition, Type V cement or equivalent according to ACI 201.2R-08 (Reference 323) is used for all the lifts for additional protection. Delivery tickets are prepared according to ACI 311.5 (Reference 324) and inspected to ensure that the water-cementitious material ratio and the type of cementitious materials for the first lift meet durability requirements in Reference 323 for Class 2 sulfate exposure.

FSAR Subsection 2.5.4.13 will be revised in a future COLA revision as follows:

2.5.4.13 References

323. American Concrete Institute, *Guide to Durable Concrete* (ACI 201.2R-08), 2008.

324. American Concrete Institute, *Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete* (ACI 311.5-04), 2004.

FSAR Subsection 14.3.3.5 will be added in a future COLA revision as follows:

14.3.3.5 Concrete Fill ITAAC

Subsection 2.5.4.5 discusses, in part, the excavations, backfill (including cementitious construction material) and earthwork analyses for Seismic Category I structures. The objective of this concrete fill ITAAC is to ensure reliable performance of the foundation bearing material over the life of the plant. Specifically, proper ITAAC are specified to ensure the first lift of concrete fill material is resistant to sulfate attack. By verifying water-cementitious material ratio and cement type, this ITAAC provides a method to confirm that sulfate-resistant properties of the fill material are achieved.

The following ITAAC will be added to the COLA, Part 10, Appendix B:

Table 3.8-5
Concrete Fill

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
First lift of concrete fill placed under the nuclear island basemat, containment building, shield building, and auxiliary building, meets durability requirements of ACI 201.2R-08, Table 6.3 for Class 2 sulfate exposure.	Delivery tickets will be prepared according to ACI 311.5 and inspected to ensure that the first lift of concrete fill (minimum thickness of 2.5 feet) meets durability requirements of ACI 201.2R-08, Table 6.3 for Class 2 sulfate exposure.	The first lift of concrete fill (minimum thickness of 2.5 feet) meets durability requirements of ACI 201.2R-08, Table 6.3 for Class 2 sulfate exposure.

Note: The ITAAC presented in the Response to RAI 02.05.04-33 will be in addition to this Concrete Fill ITAAC.

ASSOCIATED ENCLOSURES:

None

NRC RAI Letter No. PTN-RAI-LTR-040

SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations

QUESTIONS from Geosciences and Geotechnical Engineering Branch 1 (RGS1)

NRC RAI Number: 02.05.04-32 (eRAI 7811)

FSAR Subsection 2.5.4.5.1 indicated three offsite structural fill sources. The applicant stated that "Each of these sources, as well as onsite material excavated from the power block excavations, offers Miami Limestone (Stratum 2) material and other limestone derived materials in granular form. This material is locally known as limerock." The applicant further stated that "The results of laboratory index tests (natural moisture content, gradation), chemical tests (pH, sulphate content, chloride content), moisture-density relationship tests (modified Proctor compaction), and strength tests (LBR and CBR) for these materials are contained in Appendix E.1 of Reference 257." Regulatory Guide 1.206 Section C.I.2.5.4.5, "Excavations and Backfill", states that the applicant should discuss sources and quantities of backfill and borrow, including a description of exploration and laboratory studies and the static and dynamic engineering properties of these materials. In accordance with 10 CFR 100 and given that the materials from offsite sources are potential Category I engineered fill, please provide the following to assist NRC staff's further review in this area:

1. Clarification of any material tests conducted for offsite structural fill sources.
2. Similarities and dissimilarities of offsite "limerock" with onsite Miami Limestone, including a description of exploration and laboratory studies and the static and dynamic engineering properties of these materials.
3. Adequacy of fill material to borrow for Category I engineered fill.

FPL RESPONSE:

Part 1)

As discussed in FSAR Subsection 2.5.4.5.1.1, three potential sources for offsite structural fill have been identified. The onsite backfill sources correspond to the limestone material that will be excavated at the project site, i.e., Miami Limestone and Key Largo Limestone materials. The compaction properties of the Miami Limestone backfill source have been evaluated; the material was sampled via two test pits, and the results are provided in Appendix E.1 of FSAR Subsection 2.5.4 Reference 257, and are summarized in FSAR Table 2.5.4-214. Chemical tests for onsite sources have been performed and the results are summarized in FSAR Table 2.5.4-205. Based on onsite chemical test results presented in FSAR Table 2.5.4-205 and the guidelines for the evaluation of soil chemistry presented in FSAR Table 2.5.4-211, both the Miami Limestone and the Key Largo Limestone have a sulfate content that is classified as mild against concrete. The AP1000 DCD Tier 1, Table 3.3-6 provides Inspection, Tests, Analyses, and Acceptance Criteria (ITAAC) to ensure that the exterior walls and the basemat of the nuclear island have a water barrier up to site grade. Since the water barrier will eliminate contact between the fill and the nuclear island exterior walls and basemat, any potential sulfate or chloride attack on the concrete will be minimized.

Laboratory compaction tests will be performed for the Key Largo limestone and offsite structural fill sources and chemical tests will be performed for offsite structural fill sources prior to earthwork operations.

As stated in FSAR Subsection 2.5.4.5.3, borrow sources are qualified prior to earthwork operations by testing for index properties, chemical properties, and engineering properties, especially: grain size and plasticity; soil pH, sulfate content, chloride content and moisture-density relationships. Further, FSAR Subsection 2.5.4.5.3 states that the backfill around the nuclear island structures (Category I engineered fill) will be compacted to a minimum of 95 percent of modified Proctor maximum dry density. These requirements as well as fill placement and compaction control procedures will be included in a technical specification that will be prepared during the detailed project design phase.

Part 2)

Any offsite backfill material, or “limerock,” if necessary for Category I engineered fill will be obtained from local quarries. As discussed in FSAR Subsection 2.5.4.5.1.1, the identified offsite structural fill sources offer local “limerock,” or crushed limestone material, which can be graded into a variety of grain size distributions. The quarries identified as likely offsite structural fill sources are all located within Miami-Dade County. As shown in FSAR Figure 2.5.1-201, Miami Limestone material is present throughout Miami-Dade County; therefore the local quarries identified are expected to have Miami Limestone material, similar to that observed at the Turkey Point Units 6 & 7 site available. Due to the gentle dip of the geologic strata in southeastern Florida, the Miami and Key Largo Limestones are at, or near, the surface throughout Miami-Dade County (FSAR Figure 2.5.1-201). Geologists or geotechnical engineers will verify from visual observation (i.e., texture, hardness, etc.) and laboratory testing, as indicated in FSAR Subsection 2.5.4.5.3, that the offsite backfill material is acceptable for use.

Part 3)

In order to determine the quantity of an available onsite backfill material for Category I engineered fill, a cut-fill calculation has been performed. Approximately 67,000 yd^3 of limestone or limerock will be excavated for each unit, and 64,700 yd^3 of Category I fill is required for each unit. Therefore, onsite limerock is likely adequate in terms of amount; however, offsite sources might be necessary for Category I fill.

References:

None

ASSOCIATED COL APPLICATION REVISIONS:

The second paragraph of FSAR Subsection 2.5.4.2.1.2.9 will be revised in a future COLA revision as follows:

2.5.4.2.1.2.9 Compacted Limerock Fill

The muck layer underneath the power block area is removed and replaced with compacted limerock fill from onsite excavated Miami Limestone**, Key Largo,** and offsite sources, with fill placement starting from approximately El. –5 feet and building up to El. +25.5 feet. Excavations and fill on other areas of the site as described in Subsections 2.5.4.3 and 2.5.4.5 are completed. All other non-Category I structures are supported on compacted limerock fill.

The first and fourth paragraphs of FSAR Subsection 2.5.4.2.1.4.1 will be revised in a future COLA revision as follows:

2.5.4.2.1.4.1 Laboratory Chemical Testing and Evaluation

Twenty-three sets of chemical analysis, consisting of pH, chloride content, and sulfate content, are performed on samples from the power block areas. Depths range from ground surface to approximately 155 feet. Samples tested are from the muck/peat, Miami Limestone, Key Largo Limestone, Fort Thompson Formation, and upper Tamiami Formation. Test results are summarized in Table 4.6 of Reference 257 and Table 4 of Reference 290. As noted in Subsection 2.5.4.5.1, the nuclear island is supported on ~~lean~~ concrete backfill and surrounded by limerock structural fill. Buried piping, duct banks, etc. are founded in limerock structural fill placed from about El. –5 feet (bottom of excavated muck) to El. +25.5 feet (final plant grade). ~~Thus, the chemical properties of the in-situ soils discussed in the following paragraphs do not impact the nuclear island or buried utilities in the power block area~~.

Measured sulfate contents for the same soils are analyzed. The range for the sulfate content is from 198 ppm to 7590 ppm (equivalent to 0.02 to 0.76 percent). Only one sample contains greater than 1190 ppm (0.119 percent). The sample with the highest sulfate is from the muck stratum (which is removed during construction). Thus, one sample from the muck stratum tested indicates severe aggression towards exposed concrete, but as noted above this stratum is removed. The sulfate content results from the Miami Limestone, Key Largo Limestone, Fort Thompson Formation, and upper Tamiami Formation indicate mild to moderate aggression toward concrete. Based on the guidance from applicable references summarized in Table 2.5.4-211, Type II cement is considered acceptable for nonsafety-related structures that are in contact with these in-situ materials. **DCD Tier 1, Table 3.3-6 provides an ITAAC to ensure that the exterior walls and the basemat of the nuclear island have a water barrier up to site grade. Since the water barrier will eliminate contact between the fill and the nuclear island exterior walls and basemat, any potential sulfate or chloride attack on the concrete will be minimized.**

The first paragraph of FSAR Subsection 2.5.4.5.1.1 will be revised in a future COLA revision as follows:

2.5.4.5.1.1 Replacement of Stratum 1 with Compacted Limerock Fill

Due to the poor soil properties of Stratum 1 (muck/peat), Stratum 1 is removed in its entirety prior to commencing the major earthwork and grading operations. After removing the muck/peat, the grade is raised to approximately El. +0 feet through

placement and compaction of Miami Limestone **and Key Largo** fill material**s** and limerock material from other sources.

The first paragraph of FSAR Subsection 2.5.4.7.3.4 will be revised in a future COLA revision as follows:

2.5.4.7.3.4 Dynamic Properties of Structural Fill

The muck layer underneath the power block area at Units 6 & 7 is removed and replaced with compacted limerock fill from onsite excavated Miami Limestone**, Key Largo,** and offsite sources, with fill placement starting from El. –5 feet and building up to El. +25.5 feet. Non-Category I structures are supported on compacted structural limerock fill.

ASSOCIATED ENCLOSURES:

None

NRC RAI Letter No. PTN-RAI-LTR-040

SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations

QUESTIONS from Geosciences and Geotechnical Engineering Branch 1 (RGS1)

NRC RAI Number: 02.05.04-33 (eRAI 7811)

FSAR Section 2.5.4.5.1.2 and response to RAI 0.2.05.04-12 indicated that a 20 foot thick layer concrete fill will be placed beneath the nuclear islands. 10 CFR 100.23 (d) (4) requires that "Each applicant shall evaluate all siting factors and potential causes of failure, such as the physical properties of the materials underlying the site ...," and Regulatory Guide 1.206 Section C.I.2.5.4.5, "Excavations and Backfill", states that the applicant should discuss "sources and quantities of backfill and borrow, including a description of exploration and laboratory studies and the static and dynamic engineering properties of these materials. In accordance with 10 CFR 100.23 (d) (4) and Regulatory Guide 1.206 section C.I.2.5.4.5, please provide the Inspections, Tests, and Analyses and Acceptance Criteria (ITAAC) that will be used to ensure that the concrete fill placed underneath any Category I structures to a thickness greater than 5 feet, meet the design, construction and testing of applicable ACI standards.

FPL RESPONSE:

As discussed in FSAR Subsection 2.5.4.5.1.2, a 19 foot thick layer of concrete fill will be placed beneath the nuclear islands from El. –35 feet to El. –16 feet. The design and construction of the concrete fill will follow American Concrete Institute (ACI) 207, *Guide to Mass Concrete* (FSAR Subsection 2.5.4, Reference 281). The Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) that will be used to ensure that the concrete fill placed underneath Seismic Category I structures to a thickness greater than 5 feet, meet the specifications in ACI 207 are provided in Table 1, below. To ensure that the compressive strength is equal to or greater than 1500 psi, concrete test cylinders will be made in the field and tested according to ACI 311.5 (Reference 2). The ITAAC that will be used to ensure that the first lift of concrete fill meets the ACI 201.2R-08 durability requirements are provided in the Response to RAI 02.05.04-31. Additional details regarding the design and construction approach for the concrete fill will be provided in the Response to RAI 03.08.05-03.

Table 1
ITAAC for Concrete Fill under Seismic Category I Structures

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
Concrete fill placed under the nuclear island basemat, containment building, shield building, and auxiliary building, is designed, constructed, and tested as specified in ACI 207.1R-05.	(a) Testing will be performed in accordance with ACI 311.5 to determine the mean compressive strength of the concrete fill.	(a) The mean 28-day compressive strength of the concrete fill is equal to, or greater than 1500 psi.
	(b) Inspection will be performed to ensure that methods used to control thermal cracking are in accordance with ACI 207.1R-05.	(b) Methods used to control thermal cracking are in accordance with ACI 207.1R-05.

References:

1. American Concrete Institute, *Guide to Mass Concrete* (ACI 207.1R-05), Detroit, Michigan, 2006.

2. American Concrete Institute, *Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete* (ACI 311.5-04), 2004.

ASSOCIATED COLA REVISIONS:

The third paragraph of FSAR Subsection 2.5.4.5.1.2 will be revised in a future COLA revision as follows:

2.5.4.5.1.2 Power Block and Site Grade Raising

Structural fill consisting of excavated fill material is placed around but not below any nuclear island structure. Replacement material below the nuclear islands consists of ~~lean~~ concrete fill. The selection of ~~lean~~ concrete **fill** mix design is made at project detailed design. The compressive strength of 1.5 ksi is estimated for ~~lean~~ concrete fill. **To ensure that the compressive strength is equal to or greater than 1500 psi, concrete test cylinders are made in the field and tested according to ACI 311.5 (Reference 324).**

FSAR Subsection 2.5.4.13 will be revised in a future COLA revision as follows:

2.5.4.13 References

324. American Concrete Institute, *Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete* (ACI 311.5-04), 2004.

A second paragraph will be added to the new FSAR Subsection 14.3.3.5 in a future COLA revision as follows:

14.3.3.5 Concrete Fill ITAAC

Additionally, the ITAAC have been developed to ensure that the static and dynamic properties of the material will be the same as, or better than the design parameters. In general, by testing the mean 28-day compressive strength of cementitious construction material, this ITAAC provides a method to confirm that the properties (static and dynamic) of said material are met prior to the construction of the Seismic Category I structure.

The following ITAAC will be added to the COLA, Part 10, Appendix B:

Table 3.8-5
Concrete Fill

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
Concrete fill placed under the nuclear island basemat, containment building, shield building, and auxiliary building, is designed, constructed, and tested as specified in ACI 207.1R-05.	(a) Testing will be performed in accordance with ACI 311.5 to determine the mean compressive strength of the concrete fill.	(a) The mean 28-day compressive strength of the concrete fill is equal to, or greater than 1500 psi.
	(b) Inspection will be performed to ensure that methods used to control thermal cracking are in accordance with ACI 207.1R-05.	(b) Methods used to control thermal cracking are in accordance with ACI 207.1R-05.

Note: This ITAAC will be added to the Concrete Fill ITAAC presented in the Response to RAI 02.05.04-31.

ASSOCIATED ENCLOSURES:

None