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UniStar
NUCLEAR ENERGY

10 CFR 50.4
10 CFR 52.79

January 29, 2010

UN#10-027

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: UniStar Nuclear Energy, NRC Docket No. 52-016
Shear Wave Velocity Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) Update and Departure

Reference: 1) UniStar Nuclear Energy Letter UN#09-461, from Greg Gibson to Document Control Desk, U.S. NRC, Departure for Minimum Shear Wave Velocity beneath the Emergency Power Generating Buildings, dated October 30, 2009

2) UniStar Nuclear Energy Letter UN#09-519, from Greg Gibson to Document Control Desk, U.S. NRC, Update to Calvert Cliffs Nuclear Power Plant, Unit 3 FSAR Section 3.7 and response to FSAR Section 3.7 RAI sets 19, 25, 58, 63, 65,112,113,139,158,159,167,168,179,180,181, and 193, dated December 29, 2009

The purpose of this letter is to provide an update to Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Combined License Application (COLA) Part 10, Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) Table 2.4-1 to address shear wave velocity testing. UniStar Nuclear Energy submitted a departure (Reference 1) for the shear wave velocity in the fill under the Emergency Power Generating Buildings (EPGBs), and identified that the ITAAC Table would be updated following completion of the update of Final Safety Analysis Report (FSAR) Section 3.7. That update was provided in (Reference 2) which stated that a shear wave velocity ITAAC, consistent with the current industry approach, would be submitted by January 29, 2010.

Shear wave velocity ITAAC entries have been established for the three Seismic Category I buildings founded on structural fill, and for the Seismic Category II-SSE Fire Protection building

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and tanks which will also be founded on structural fill. For these buildings, acceptance criteria have been established at approximately one standard deviation less than the best estimate shear wave velocity value. These values are greater than the lower bound used in the site-specific Soil-Structure Interaction (SSI) analysis, but less than the best estimate value. These acceptance criteria will ensure that the shear wave velocity testing demonstrates that the backfill has been properly graded and installed while minimizing the potential for a false failure due to small inconsistencies in the field measured data compared to best estimate values calculated from laboratory data.

Because the ITAAC acceptance criteria are less than 1,000 feet per second, a departure is being taken for the structural fill under both the EPGBs and the Essential Service Water Buildings (ESWBs). The Ultimate Heat Sink Electrical Building (UHS EB) and the Fire Protection building and tanks are site specific structures and do not require a departure.

The enclosure provides the updated ITAAC Table 2.4-1, an update to the departure previously submitted in Reference 1, and changes to other conforming pages (also previously submitted in Reference 1).

There are no regulatory commitments identified in this letter. This letter does not contain any proprietary or sensitive information.

If there are any questions regarding this transmittal, please contact me at (410) 470-4205, or Mr. Michael J. Yox at (410) 470-6317.

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

Executed on January 29, 2010

Greg Gibson

Enclosures: Mark up pages to COLA Part 10 ITAAC; COLA Part 7, Departures and Exemption Requests; and conforming changes to COLA Part 2, Final Safety Analysis Report, Calvert Cliffs Nuclear Power Plant Unit 3

cc: Surinder Arora, NRC Project Manager, U.S. EPR Projects Branch
Laura Quinn, NRC Environmental Project Manager, U.S. EPR COL Application
Getachew Tesfaye, NRC Project Manager, U.S. EPR DC Application
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U.S. NRC Region I Office

GTG/SJS/mdf

Enclosure

Mark up pages to COLA Part 10, ITAAC; COLA Part 7, Departures and Exemption Requests; and conforming changes to COLA Part 2, Final Safety Analysis Report, Calvert Cliffs Nuclear Power Plant Unit 3

Table 2.4-1—{Structural Fill ~~and Backfill~~ Under Seismic Category I and Seismic Category II-SSE Structures Inspections, Tests, Analyses, and Acceptance Criteria}

	Commitment Wording	Inspection, Test, or Analysis	Acceptance Criteria
~~1~~	~~For Seismic Category I and Seismic Category II-SSE structures, structural fill and backfill is sound, durable, well-graded sand or sand and gravel, with maximum 25 percent fines content, and free of organic matter, trash, and deleterious materials.~~	~~Tests and inspections will be performed to establish the acceptability of the structural fill and backfill.~~	~~For Seismic Category I and Seismic Category II-SSE structures, structural fill and backfill is sound, durable, well-graded sand or sand and gravel, with maximum 25 percent fines content (minus #200 U.S. Sieve), and free of organic matter, trash, and deleterious materials.~~
~~2~~	~~The following soil properties are used for design of U.S. EPR Seismic Category I and Seismic Category II-SSE structures: a. Soil density: 1. Saturated soil ≥ 134 lb/ft^3. 2. Moist soil ≥ 128 lb/ft^3. 3. Dry soil ≥ 110 lb/ft^3. b. Angle of internal friction ≥ 35 degrees. c. Coefficient of friction acting on foundation base mats and near-surface foundations for Seismic Category I structures ≥ 0.7.~~	~~Tests will be performed to establish the static and dynamic properties of the structural fill and backfill.~~	~~The structural fill and backfill conforms to the following soil properties: a. Soil density: 1. Saturated soil ≥ 134 lb/ft^3. 2. Moist soil ≥ 128 lb/ft^3. 3. Dry Soil ≥ 110 lb/ft^3. b. Angle of internal friction ≥ 35 degrees. c. Coefficient of friction acting on foundation base mats and near surface foundations for Seismic Category I structures ≥ 0.7.~~
~~3~~	~~The installed fill and backfill for Seismic Category I and Seismic Category II-SSE foundations and walls meets the minimum soil density design requirements.~~	~~Tests will be performed during placement of the structural fill and backfill materials.~~	~~For Seismic Category I and Seismic Category II-SSE Structures, installed structural fill and backfill is compacted to minimum 95 percent of its maximum dry density, as determined based on the modified Proctor compaction test procedure, and within 3 percent of its optimum moisture content.~~
~~4~~	~~The minimum shear wave velocity (low strain best estimate average value) is 1000 ft per second at the bottom of the base mats for Seismic Category I and Seismic Category II-SSE structures.~~	~~Tests will be performed to confirm the backfill shear wave velocity at the bottom of the base mats for Seismic Category I and Seismic Category II-SSE structures.~~	~~A report exists that confirms the backfill shearwave velocity (low strain best estimate average value) is 1000 ft per second at the bottom of the base mats for Seismic Category I and Seismic Category II-SSE structures.~~

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1	Structural fill material under Seismic Category I and Category II-SSE structures is installed to meet a minimum of 95 percent of the Modified Proctor density.	Testing will be performed during placement of the structural fill material.	A report exists that concludes the installed structural fill material under Seismic Category I and Category II-SSE structures meets a minimum of 95 percent of the Modified Proctor density.
2	Shear wave velocity of structural fill material beneath the Emergency Power Generation Buildings (EPGB) is greater than or equal to 630 ft/sec at the bottom of the foundation and below.	Field measurements and analyses of shear wave velocity in structural fill will be performed when structural fill placement is at the elevation of the bottom of the foundation and at finish grade.	An engineering report exists that concludes that the shear wave velocity within the structural fill material placed under the EPGB at its foundation depth and below is greater than or equal to 630 ft/sec.
3	Shear wave velocity of structural fill material beneath the Essential Service Water Buildings (ESWB) is greater than or equal to 720 ft/sec at the bottom of the foundation and below.	Field measurements and analyses of shear wave velocity in structural fill will be performed when structural fill placement is at the elevation of the bottom of the foundation and at finish grade.	An engineering report exists that concludes that the shear wave velocity within the structural fill material placed under the ESWB at its foundation depth and below is greater than or equal to 720 ft/sec.
4	Shear wave velocity of structural fill material beneath the Ultimate Heat Sink Electrical Building (UHS EB) is greater than or equal to 720 ft/sec at the bottom of the foundation and below.	Field measurements and analyses of shear wave velocity in structural fill will be performed when structural fill placement is at the elevation of the bottom of the foundation and at finish grade.	An engineering report exists that concludes that the shear wave velocity within the structural fill material placed under the UHS EB at its foundation depth and below is greater than or equal to 720 ft/sec.
5	Shear wave velocity of structural fill material beneath the Fire Protection Buildings (FPB) and associated Fire Protection Tanks (FPT) is greater than or equal to 630 ft/sec at the bottom of the foundation and below.	Field measurements and analyses of shear wave velocity in structural fill will be performed when structural fill placement is at the elevation of the bottom of the foundation and at finish grade.	An engineering report exists that concludes that the shear wave velocity within the structural fill material placed under the FPB & FPT at their foundation depths and below is greater than or equal to 630 ft/sec.

1.1.7 Shear Wave Velocity

Affected U.S. EPR FSAR Sections: Tier 1 Table 5.0-1, Tier 2 Table 2.1-1

Summary of Departure:

The U.S. EPR FSAR identifies a minimum shear wave velocity (low strain best estimate average value at bottom of basemat) of 1,000 feet per second (fps) in Tier 1, Table 5.0-1. This 1,000 fps requirement, without identifying specific structures, is repeated in Table 2.1-1 of Tier 2. Section 2.5.2.6, *Ground Motion Response Spectrum*, of the U.S. EPR FSAR states that the applicant will confirm that the low-strain, best-estimate, value of shear wave velocity at the bottom of the foundation basemat of the Nuclear Island (NI) Common Basemat Structures is 1,000 fps, or greater. U.S. EPR FSAR Section 2.5.4.3, *Foundation Interfaces*, specifies the following requirement with respect to shear wave velocity:

> (4) adequate dynamic properties (i.e., shear wave velocity and strain-dependent modulus-reduction and hysteretic damping properties) to support the Seismic Category I structures of the U.S. EPR under earthquake loading.

Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC, have elected to consider a shear wave velocity of less than 1,000 fps under any Seismic Category I facility described in the U.S. EPR FSAR as a departure. The best estimate shear wave velocity in Fill Layer 2, the fill from 6 feet below grade (the basemat of the Emergency Power Generating Building (EPGBs)) to 22 feet below grade is 900 fps. ~~Therefore a departure from the 1,000 fps best estimate shear wave velocity criterion is required for the EPGBs.~~ The best estimate shear wave velocity beneath the Essential Service Water Buildings (ESWBs) is 1080 fps. ~~The best estimate shear wave velocity represents a midpoint shear wave velocity for the building seismic analysis. A range of acceptable shear wave velocities will be established by analysis.~~ Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC, are establishing acceptance criteria for shear wave velocity testing that are approximately one standard deviation less than the best estimate values, but greater than the lower bound values used by the site-specific Soil-Structure Interaction (SSI) analysis. Establishing acceptance criteria greater than the lower bound but less than the best estimate value will ensure that the shear wave velocity testing demonstrates that the backfill has been properly graded and installed, while minimizing the potential for a false failure of the shear wave velocity due to small inconsistencies in the field measured data resulting in an average shear wave velocity that is within the bounds of the analysis, but less than the best estimate value from laboratory testing. Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC, have established 630 fps and 720 fps as the acceptance criteria for the EPGBs and ESWBs respectively. Since these values are less than 1,000 fps, this constitutes a departure.

Scope/Extent of Departure:

This Departure is identified in CCNPP Unit 3 FSAR Table 2.0-1 and Section 2.5.4.2.5.8, and in COLA Part 10, ITAAC, Table 2.4-1.

Departure Justification:

The fill selected for CCNPP Unit 3 is competent material. It has a moist unit weight of 145 lb/ft^3 and an angle of internal friction of more than 40°. Both of these values exceed the U.S. EPR established criteria in Section 2.5.4.2, *Properties of Subsurface Materials*. ~~Shear wave velocity is a function of both the material and the confining pressure of the overlying soils (or structures). Because of the lack of confining pressure, a best estimate shear wave velocity of 1,000 fps or more is unlikely to be obtained immediately below a shallow foundation structure. However, this criterion can be met for CCNPP Unit 3 Seismic Category I structures except for the EPGBs, which have a foundation depth of 6 feet.~~

The U.S. EPR FSAR Tier 1 also states in Section 5.0:

> In the case of seismic design parameters, deviations from the defined conditions may be justified by site-specific soil-structure interaction analyses. The results may be used to confirm the seismic design adequacy of the certified design using approved methods and acceptance criteria.

The site-specific Soil-Structure Interaction (SSI) analysis ~~of the structures in FSAR Section 3.7 uses the low strain best estimate shear wave velocities established for the soil column beneath the evaluated facilities. The 900 fps best estimate shear wave velocity in Fill Layer 2 is used as an input for the analysis of the EPGBs. More specifically, the analysis~~ performed for FSAR Section 3.7 establishes a range of acceptable shear wave velocities beneath the ESWBs and EPGBs~~building~~. The lowest acceptable shear wave velocity is a lower bound and the highest is an upper bound. This analysis demonstrates that the EPGBs withstand the safe shutdown earthquake (SSE) for that range of shear wave velocities.

Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) testing will be performed during construction to confirm that the shear wave velocity of the installed and compacted fill exceeds the lower bound shear wave velocity used in the FSAR Section 3.7 analysis. ~~of the EPGB~~. This ITAAC testing demonstrates acceptability of this aspect of the building seismic analysis.

Departure Evaluation:

This Departure, associated with the shear wave velocity for the fill beneath the Emergency Power Generating Buildings has been evaluated and determined to not adversely affect the safety function of these structures. Accordingly, this Departure does not:

1. Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the plant-specific FSAR;

2. Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety and previously evaluated in the plant-specific FSAR;

3. Result in more than a minimal increase in the consequences of an accident previously evaluated in the plant-specific FSAR;

4. Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the plant-specific FSAR;

5. Create a possibility for an accident of a different type than any evaluated previously in the plant-specific FSAR;

6. Create a possibility for a malfunction of an SSC important to safety with a different result than any evaluated previously in the plant-specific FSAR;

7. Result in a design basis limit for a fission product barrier as described in the plant-specific FSAR being exceeded or altered; or

8. Result in a departure from a method of evaluation described in the plant-specific FSAR used in establishing the design bases or in the safety analyses.

This Departure does not affect resolution of a severe accident issue identified in the plant-specific FSAR.

Therefore, this Departure has no safety significance.

1.2.8 Shear Wave Velocity

Applicable Regulation: 10 CFR Part 52

The U.S. EPR FSAR Tier 1 Table 5.0-1, and Tier 2 Table 2.1-1, identifies a minimum shear wave velocity (low strain best estimate average value at bottom of basemat) of 1,000 feet per second (fps).

The best estimate shear wave velocity in Fill layer 2, the fill from 6 feet below grade (the basemat of the Emergency Power Generating Building (EPGBs)) to 22 feet below grade is 900 fps. The best estimate shear wave velocity beneath the Essential Service Water Buildings (ESWBs) is 1080 fps. Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC, are establishing acceptance criteria for shear wave velocity testing that are approximately one standard deviation less than the best estimate values, but greater than the lower bound values used by the site-specific Soil-Structure Interaction (SSI) analysis. Establishing acceptance criteria greater than the lower bound but less than the best estimate value will ensure that the shear wave velocity testing demonstrates that the backfill has been properly graded and installed, while minimizing the potential for a false failure of the shear wave velocity due to small inconsistencies in the field measured data resulting in an average shear wave velocity that is within the bounds of the analysis, but less than the best estimate value from laboratory testing. Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC, have established 630 fps and 720 fps as the acceptance criteria for the EPGBs and ESWBs respectively. Since these values are less than 1,000 fps, this constitutes a departure.

Therefore this U.S. EPR criterion is not met.

Pursuant to 10 CFR 52.7 and 10 CFR 52.93, Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC request an exemption from compliance with the U.S. EPR FSAR Tier 1 and 2 requirements associated with the minimum shear wave velocity.

Discussion:

The U.S. EPR FSAR identifies a minimum shear wave velocity (low strain best estimate average value at bottom of basemat) of 1,000 fps in Tier 1, Table 5.0-1. U.S. EPR FSAR Tier 1 Section 5.0 also states:

> In the case of seismic design parameters, deviations from the defined conditions may be justified by site-specific soil-structure interaction analyses. The results may be used to confirm the seismic design adequacy of the certified design using approved methods and acceptance criteria.

This 1,000 fps requirement, without identifying specific structures, is repeated in Table 2.1-1 of Tier 2. Section 2.5.2.6, *Ground Motion Response Spectrum*, of the U.S. EPR FSAR states that the applicant will confirm that the low-strain, best-estimate, value of shear wave velocity at the

bottom of the foundation basemat of the Nuclear Island (NI) Common Basemat Structures is 1,000 fps, or greater.

U.S. EPR FSAR Section 2.5.4.3, *Foundation Interfaces*, specifies the following requirement with respect to shear wave velocity:

> (4) adequate dynamic properties (i.e., shear wave velocity and strain-dependent modulus-reduction and hysteretic damping properties) to support the Seismic Category I structures of the U.S. EPR under earthquake loading.

~~The best estimate shear wave velocity in Fill Layer 2, the fill from 6 feet below grade (the basemat of the Emergency Power Generating Building (EPGBs)) to 22 feet below grade is 900 fps.~~ The fill selected for CCNPP Unit 3 is competent material. It has a moist unit weight of 145 lb/ft^3 and an angle of internal friction of more than 40°. Both of these values exceed the U.S. EPR established criteria. Shear wave velocity is a function of both the material and the confining pressure of the overlying soils (or structures). Because of the lack of confining pressure, a best estimate shear wave velocity of 1,000 fps or more is unlikely to be obtained immediately below a shallow foundation structure.

The site-specific Soil-Structure Interaction (SSI) analysis ~~of the structures in FSAR Section 3.7 uses the low-strain best estimate shear wave velocities established for the soil column beneath the evaluated facilities. The 900 fps best estimate shear wave velocity in Fill layer 2 is used as an input for the analysis of the EPGBs. More specifically, the analysis~~ performed for FSAR Section 3.7 establishes a range of acceptable shear wave velocities beneath the ESWBs and EPGBs~~building~~. The lowest acceptable shear wave velocity is a lower bound and the highest is an upper bound. This analysis demonstrates that the EPGBs withstand the safe shutdown earthquake (SSE) for that range of shear wave velocities.

Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) testing will be performed during construction to confirm that the shear wave velocity of the installed and compacted fill exceeds the lower bound shear wave velocity used in the FSAR Section 3.7 analysis ~~of the EPGB~~. This ITAAC testing demonstrates acceptability of this aspect of the building seismic analysis.

This change associated with the shear wave velocity below the EPGB and ESWB foundations has been evaluated and determined to not adversely affect the safety function of these structures. Therefore, this change will not result in a significant decrease in the level of safety otherwise provided by the design described in the U.S. EPR FSAR.

The exemption is not inconsistent with the Atomic Energy Act or any other statute. As such, the requested exemption is authorized by law.

This change does not result in a departure from the design and does not require a change in the design described in the U.S. EPR FSAR. In addition, the change has been evaluated and

determined to not adversely affect the safety function of the associated structures. Therefore, the requested exemption will not present an undue risk to the public health and safety.

The change does not relate to security and does not otherwise pertain to the common defense and security. Therefore, the requested exemption will not endanger the common defense and security.

The special circumstance necessitating the request for exemption is that the fill below the EPGB and ESWB foundations will not meet the minimum shear wave velocity of 1,000 fps identified in the U.S. EPR FSAR. However, the EPGBs and ESWBs have been evaluated using the properties of the existing soil column and the selected fill and the lower shear wave velocity of the fill has been determined to not adversely affect the safety function of these structures. As such, application of the regulation for this particular circumstance would not serve the underlying purpose of the rule and is not required to achieve the underlying purpose of the rule.

This requested exemption does not require a change in the design described in the U.S. EPR FSAR. Therefore, this exemption will not result in any loss of standardization.

For these reasons, Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC request approval of the requested exemption from compliance with the U.S. EPR FSAR Tier 1 and 2 requirements associated with shear wave velocity.

Changes to COLA Part 2, Final Safety Analysis Report
Previously provided in UniStar letter UN#09-461
dated October 30, 2009

Additional text added to FSAR Section 1.8.2:

1.8.2 DEPARTURES

The U.S. EPR FSAR includes the following COL Item in Section 1.8.2:

> A COL applicant that references the U.S. EPR design certification will provide a list of any departures from the FSAR in the COL FSAR.

This COL Item is addressed as follows:

and COLA Part 10, ITAAC, Table 2.4-1

{The list of departures from the U.S. EPR FSAR is as follows:

Maximum Differential Settlement	FSAR 2.5.4 and 3.8.5
Maximum Annual Average Atmospheric Dispersion Factor	FSAR 2.3.5
Accident Atmospheric Dispersion Factor from 0 - 2 Hours for theLow Population Zone	FSAR 2.3.4 and 15.0.3
Maximum Ground Water Elevation	FSAR 2.4.12, 3.4.2, and 3.8.5
Toxic Gas Detection and Isolation	FSAR 3.11, 6.4, 9.4.1 and 14.2.12
Technical Specifications Setpoint Control Program	FSAR 16.3.3, 16.5.5, and Bases 16.3.3
Shear Wave Velocity	FSAR 2.5.4.2.5.8

Justification for these departures is presented in Part 7 of the COL application.}

Changes to FSAR Table 2.0-1:

	U.S. EPR FSAR Design Parameter Value/Characteristic	**CCNPP Unit 3 Design Parameter Value/Characteristic**
Minimum Shear Wave Velocity (Low strain best estimate average value at bottom of basemat)	1000 fps	~~1450 fps (See Section 2.5.2.6) 900 fps at bottom of Emergency Power Generating Building basemats (note h)~~ ~~≥ 1000 fps for other Seismic Category I buildings (See Sections 2.5.2.6 and 2.5.4)~~

Notes:
h. Value is a departure from a design parameter and is listed in Part 7 of the COL Application. Justification is provided by the analysis in Section 3.7.

>= 1000 fps for the NI and UHS MWIS and Forebay (see section 2.5.2.6 and 2.5.4)
.
>= 720 fps for the ESWB (note h)
>= 630 fps for the EPGB (note h)
>= 720 fps for the UHS EB
>= 630 fps for the Cat II-SSE FP building and tanks