Los Alamos NATIONAL LABORATORY EST. 1943

Conduct of Engineering
Request for Variance or Alternate Method

To display the *VAR Request Metadata* pane for this document, click **File > Info > Properties > Show Document Panel.**

1.0 General

1.1 Document Number: VAR-10737	1.2 Revision: 0
1.3 Brief Descriptive Title: Earthwork – Subgrade Preparation for Shallow Foundations	
1.4 Affected Program: Engineering Standards	1.5 Request Type: Variance
1.6a Affected Tech Area 99	1.6b Affected Buildings Sitewide
1.7 Requestor: Baca, Victoria R Organization: ES-WPD	
1.8 Revision History Revision Number Changes and Comments 0 Initial issue.	

2.0 Affected Conduct of Engineering Program/Documents

2.1 Affected "P" Document: P342 Engineering Standards If against the P document itself, revision (or ***N/A***): N/A	2.2 Subordinate or related document(s) [AP, master spec, LANL ESM chapter & section; or code, Order, standard, etc.]: Document Title/No.: ESM Chapter 3, Section G10. Revision 3 Document Title/No.: TSM Chapter 3. Revision 3 Document Title/No.: Enter text.. Revision Enter text..
2.3 Section/Paragraph: ESM Chapter 3, Section G10, G1030 Site Earthwork, 2.0 Earthwork, B; 3.0 Compaction, A-Density; TSM, Chapter 3, Part 2.0 Site Preparation B (3) and C	
2.4 Specific Requirement(s) as Written in the Document(s): Subgrade Preparation in ESM Ch 3, G10, G1030, 2.0.B: Define subgrade preparation as a minimum the top 6 to 12 inches of site work under structural foundations slabs and pavement. It shall be scarified, moistened to optimum conditions, and compacted to 95% of maximum density. If unsound areas, soft spots, are discovered the areas shall be removed and replaced with structural backfill. Limit elevation tolerance to plus or minus 0.05 ft. per 10 ft. in any direction from specified grade and cross section. Finish slopes may exceed a 2:1 slope in special cases when recommended by a registered professional geotechnical engineer.	

Compaction Testing in ESM Ch 3, G10, G1030, 3.0.A:

Determine the optimum density in accordance with ASTM D6938 or ASTM D1557. Determine field control of density of in-place material in accordance with Nuclear Method (ASTM D6938) or the Laboratory Determination (ASTM D4253) for relative density of cohesionless soil.

Subgrade Preparation in TSM Ch 3, 2.0.B.3:

Treat the top 6-12 inches beneath foundations, slabs, and pavement by scarifying, moistening, and compacting to 95% density. Unsound areas must be replaced with structural backfill. Elevation tolerance is plus or minus 0.05 feet per 10 feet. Finish slopes may exceed 2:1 if recommended by a geotechnical engineer.

Compaction Testing in TSM Ch 3, 2.0.C:

Compact to 95% of maximum density as determined to ASTM D1557; adjust based on soil type and use case.

1. If competent volcanic tuff is encountered, it is exempt from the 95% compaction requirement; only the fill above needs to meet the 95% compaction requirement, as determined by the EOR.

2.5 Contractual, preference, or other basis for requirement in 2.4:

LANL preference on subgrade preparation and industry standard on compaction testing.

2.6 Type of VAR from ESM Chap 1, Z10 [*Applies only to standards variances*)	2.7 Discipline
Type 2	Civil

3.0 Request Information & Comments

3.1 NCR required (work has occurred)? No

If Yes, NCR Number: Enter text.

3.2 System/Component Affected N/A OpSystem Acronym & Name [Select OpSysAcronymAndName] System Number or Name [Select SystemNumberOrName]	3.3 Highest ML Level ML-1

3.4 Proposal with Justification/Compensatory Measures:

Background:

Traditionally, the ESM and TSM, Chapter 3 (Civil) have required scarification and compaction of the existing subgrade may not be practical for existing soil conditions and minor foundations. The proposal below is intended to address this.

Proposal:

1. Subgrade Preparation: Incorporate the requirements of IBC 2021 Section 1809, Shallow Foundations to the ESM and TSM Chapter 3 (Civil) for Subgrade Preparation beneath minor structural foundations such as individual footings and equipment pads.

The existing requirements define a specific treatment of the top 6 to 12 inches of site soil, to include scarification, moisture conditioning to optimum levels, and compaction to 95% of maximum dry density. IBC

2021, Section 1809 – Shallow Foundations requires shallow foundations to be on placed on undisturbed soil, compacted fill material (e.g., structural fill), or controlled low-strength material (CLSM) (e.g., flowable fill).

The revised language below shall replace subgrade preparation and compaction testing requirements listed in Field 2.4:

Subgrade is defined, as a minimum, as the top 6 to 12 inches of site work under structural foundations, slabs and pavement.

Subgrade preparation beneath structural foundations shall be as follows:

1. Minor structural foundations, such as individual footings and equipment pads, shall be supported on undisturbed natural soil, compacted fill material, or controlled low-strength material (e.g., flowable fill). Compacted fill material shall be placed per IBC Section 1804.6. CLSM shall be placed per Section IBC 1804.7.
2. If structural fill is used, it shall be moisture-conditioned to within 2% of the optimum moisture content and compacted to a minimum of 95% of the maximum dry density per ASTM D1557 (for minor structural foundations, see compaction testing below).
3. If unsound areas or soft spots are encountered, they shall be excavated and replaced with structural backfill compacted to the above standard.
4. For major/critical structural foundations (e.g., building slabs-on-grade foundations, mat foundations), EOR is responsible to provide subgrade preparation requirements in coordination with the geotechnical engineer's recommendations, as applicable.
5. Final subgrade elevations shall meet a tolerance of ±0.05 feet per 10 feet in any direction from the specified grade or cross-section.
6. Finish slopes may exceed a 2:1 ratio only when specifically recommended by a registered professional geotechnical engineer, based on a site-specific evaluation.

Compaction Testing

1. For minor shallow foundations such as individual footings and equipment pads, utilize engineering judgement when specifying 95% compaction testing of the subgrade or compacted fill. Consider if a well-compacted subgrade and/or fill is sufficient for site conditions and loading (e.g., light load, non-critical foundations, or not required per IBC 2021 Section 1809.2 and, if applicable, Section 1804.6).
2. For major/critical foundations, compact to 95% of maximum density as determined per ASTM D1557; adjust based on soil type, use case, and geotechnical engineer's recommendations, as applicable.
3. If competent volcanic tuff is encountered, it is exempt from the 95% compaction requirement; only the fill above needs to meet the 95% compaction requirement, as determined by the EOR.

Justification

Subgrade Preparation

- Incorporates the requirements of IBC 2021 Section 1809
- Avoids subgrade disturbance due to scarification process
- Undisturbed natural soil and compacted fill provide better assurance of long-term performance
- Reduces the risk of differential settlement, bearing capacity failures, and differential movement.

Compaction Testing

- Engineering judgement supports decisions based on actual conditions and performance potential
- Field evaluations would be conducted by an FE and foundation inspector per IBC 2021 Section 110.3.1

- Supports construction efficiency by allowing projects to progress smoothly without sacrificing safety or code compliance
- The laboratory lacks sufficient resources to support geotechnical analysis (i.e., proctor) for minor foundations
- Reduces over-specification for minor elements and avoids unnecessary testing or rework.

3.5 Attachments

Document Title or Description N/A

3.6a Project ID	3.6b: Project Name	3.6c: Code of Record Date
N/A	N/A	N/A

3.7 Duration:	3.8a If Finite Period, Start Date:	3.8b End Date:
Lifetime	Click to enter a date.	Click to enter a date

3.8c Provide the PFITS number for tracking removal/correction: [PFITSNum]

3.9 USQD/USID required (Nuclear, High/Mod Hazard)? No

If Yes, USQD/USID Number Click here to enter text.

3.10 QA Review for process change matters potentially affecting LANL's NQA-1 implementation

Is a QPA Determination required?: No If ***Yes***, then: Choose an item.

QPA Comments: Enter text..

3.11 POC Determination: Accept

POC Comments: Enter text..

3.12 Management Program Owner's (SMPO) Approval for P341 and APs; P342, ESM, ML-1 and -2, and Contract Matters; and P343

SMPO Determination: Accept

Comments: Enter text..

4.0 Participant Signatures

NOTE: *DO NOT ADD NAMES FROM WITHIN WORD! Save and close the form first, then do 1-4 below:*

1. *From the SharePoint library, select the document, then click the **ellipsis** (…) in the second column; a small dialog appears*
2. *In the small dialog click the **ellipsis** again*
3. *Click **Edit Properties** and check out the document if prompted toEnter names using the controls provided, then **Save***

4.1 POC (Management Program Owner's Representative):	Organization	Signature
Baca, Victoria R	ES-WPD	VICTORIA BACA (Affiliate) Digitally signed by VICTORIA BACA (Affiliate) Date: 2025.06.05 10:03:19 -06'00'

4.2 Facility Design Authority Representative [FDARName] FDAR signature not required ☒	Organization Enter text..	Signature
4.3 LANL Owning Manager (FOD or R&D/Program) [FODorPrgmMgrName] FOD or Program Manager signature not required ☒	Organization Enter text..	Signature
4.4 Quality Reviewer's Name: [QPAName] QPA review/signature not required ☒	Organization Enter text.	Signature
4.5 Safety or Security Management Program Owner's Approval for P341 and APs; P342, ESM and Contract Matters; and P343 Richardson, Michael Joseph SMPO signature not required (Type 1 variance) ☐	Organization ES-DO	Signature MICHAEL RICHARDSON (Affiliate) Digitally signed by MICHAEL RICHARDSON (Affiliate) Date: 2025.06.11 07:21:10 -06'00'
4.6 Additional Signer 1 [AdditionalSigner1] Role: Enter text.	Organization Enter text.	Signature
4.7 Additional Signer 2 [AdditionalSigner2] Role: Enter text.	Organization Enter text.	Signature

4.8 CoE Administrator Signature Leyba, Matthew Anthony NOTE: The CoE Admin is always the last signature placed on this document. The date of that signing is the date of this document.	Signature Matthew Leyba Digitally signed by Matthew Leyba Date: 2025.06.12 10:28:30 -06'00'