

APPENDIX H

Miscellaneous Information

RUTHERFORD & CHEKENE

Volume 1 –Geotechnical Data and Investigation Report- #2003-060G2
Linac Coherent Light Source Tunnel Project, SLAC

Linac Coherent Light Source Tunnel Project Geotechnical Investigation and Engineering – Phase 2 Scope of Requested Services May 28, 2004

This subcontract includes geotechnical investigation and engineering services in support of design of various facilities for the Stanford Linear Accelerator Center (SLAC), Linac Coherent Light Source (LCLS). Facilities will include tunnels, underground buildings, aboveground buildings, roads, parking areas and utilities. A previous phase of geotechnical investigation and engineering for the project was performed in mid-2003. This phase of geotechnical investigation and engineering will provide additional data for final engineering of the facilities. The subcontractor will serve as geotechnical engineer of record for the LCLS project, working closely with the architectural/engineering design firm, Jacobs Engineering, and with SLAC.

A. Review of Existing Documents and Preparation of Work Plan

Subcontractor shall review and compile available published and geologic data for the site and vicinity, and review historical documents available at SLAC, in particular the reports on the first phase of the LCLS geotechnical investigation¹. Subcontractor shall prepare a Work Plan for review and approval by the University.

B. Subsurface Exploration

1. Drilling Permit

- a) Subcontractor shall obtain a drilling permit from San Mateo County.

2. Drilling of 6 borings

- a) Subcontractor shall advance six exploratory soil and rock borings (LCLS-1 to LCLS-6) at locations shown on Attachment A, at locations selected and staked by SLAC.

| Boring Number | Surface Elevation (ft) | Depth of Boring below surface (ft) | Additional drilling depth for geophysical survey (ft) | Total Depth of drilling (ft) |
|---------------|------------------------|------------------------------------|---|------------------------------|
| LCLS-1 | 245 | 30 | | 30 |
| LCLS-2 | 245 | 30 | | 30 |
| LCLS-3* | 270 | 35 | 15 | 50 |
| LCLS-4 | 300 | 65 | | 65 |
| LCLS-5 | 335 | 100 | 15 | 115 |
| LCLS-6 | 340 | 105 | | 105 |

* Note – two separate (different diameter) borings will be required in this area, one for sampling and geophysical testing and the other for pressuremeter testing.

¹ “Geotechnical Data Report” and “Tunneling Memorandum”, Rutherford & Chekene, 1 August 2003

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- b) Collect soil and rock samples for geotechnical analysis.
 - c) Collect samples for environmental analysis by University. Steam clean samplers between samples in accordance with SLAC environmental procedures. Collect up to 5 samples at depths requested by the University in each boring not being subjected to pressuremeter testing.
 - d) The University will provide 55 gallon drums for collection of soil cuttings and waste water generated by the project, and will be responsible for sampling and disposal of wastes.
3. Geophysical Logging of Two Borings
- a) Perform a geophysical survey to develop shear wave velocity profiles in two (LCLS-3 and LCLS-5) of the borings.
 - b) Use the P-S suspension logging method, with a 15 ft rathole.
4. Pressuremeter Tests at Two Locations
- a) Perform pressuremeter testing at two locations (LCLS-3* and LCLS-6) to determine the insitu deformation modulus. Sample and log the two holes used for pressure meter testing. The tests shall be performed at 5-ft intervals.
5. Engineers' and Geologists' Time
- a) This task includes the general preparation and coordination by the geotechnical engineer.
 - b) All borings shall be logged by a geologist during drilling and testing and the logs included in the investigation report.

C. Laboratory Testing

1. Engineering tests on Soil and Rock samples

For purposes of this bid, assume the following number of samples and analysis:

Moisture/density/porosity – 6 samples

Unconfined compression with and without modulus measurement – 4 samples

Triaxial (consolidated, undrained) – 9 samples

R-value – 3 samples

Slake durability – 2 samples

Creep – 2 samples

Shrink-swell – 4 samples

Cerchar abrasion tests – 2 samples

2. Corrosion potential test on samples

Corrosion potential – 6 samples

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D. Site Response Analysis

1. Perform non-linear site response analyses on rock/soil columns at four cross section along the alignment of the proposed LCLS project. Use ground motion data developed by Stanford University for its two earthquake hazard levels: Operating Design Earthquake (ODE) and Maximum Design Earthquake (MDE).
2. Utilize the information from the geophysical survey to characterize the soil/rock columns, which will then be subjected to the ODE and MDE in the response analyses. Use the results of the analyses to establish tunneling and buried structures parameters requested in Attachment B.

E. Synthesis of Field and Lab Data

1. Effort required to collect, check and tabulate field and lab data.

F. Engineering Analysis/Recommendations

1. Combine information from this and previous investigations² to perform geotechnical analysis, develop conclusions and/or recommendations regarding the following:
 - a) Site soil profile classification in accordance with the 2001 California Building Code
 - b) Near source factors and seismic source types
 - c) Liquefaction potential and potential impacts, if applicable
 - d) Poisson's ratio, density, friction coefficient, cohesion, and other soil properties
 - e) Appropriate foundation types for new construction and corresponding design criteria
 - f) Subgrade moduli and other geotechnical parameters for structural modeling purposes.
 - g) Passive pressure and friction factor recommendations for the design of footings under lateral loads
 - h) Static and dynamic lateral pressures on retaining walls
 - i) Estimates of settlement induced by new building loads and earthquake-induced vibrations
 - j) Estimates of aerial subsidence, if applicable
 - k) Maximum cut and fill slopes and recommended gradients
 - l) Recommendations relating to corrosion potential, floor slab and paving
 - m) Earthwork and other geotechnical issues pertinent to the project.

G. Meetings

1. Meeting as needed with design team and phone calls.

H. Deliverables

1. Presentation at SLAC to the design team of final results and recommendations. Submit 3 hard copies and one electronic copy on CD.
2. Draft and Final Geotechnical Data and Investigation Report containing conclusions and design recommendations. Submit 3 hard copies and 1 electronic copy on CD in pdf or Microsoft word format.

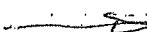
² "Geotechnical Data Report" and "Tunneling Memorandum", Rutherford & Chekene, 1 August 2003


SLAC Geotechnical Investigation and Report Needs List

1. Structural

a. Recommended types of footings:

1) If spread footings:

- a) Allowable¹ bearing capacities DL
Allowable¹ bearing capacities DL + LL
Allowable¹ bearing capacities DL + LL + EQ or WL
- b) Horizontal sliding friction factor¹
- c) Bottom of footing elevation 

 Near Hall
Only

2) If pile foundations or drilled caissons:

- a) Allowable¹ pile load DL
Allowable¹ pile load DL + LL
Allowable¹ pile load DL + LL + EQ or WL
- b) Allowable¹ spacing
- c) Lateral bearing value¹ (See Table 18-I-A, 2001 California Building Code)

Research Yard
BTA

- b. Active, allowable passive and seismic soil pressures on structures in contact with soil.
- c. Estimated immediate and long-term differential settlements
- d. Water table depth
- e. Soil properties: density, internal friction, cohesion, unit weights
- f. Provide the following corrosion indicators:
 - 1) Soil resistivity
 - 2) Corrosion potential for ferrous metals in contact with soil or ground water
 - 3) Sulfate content
 - 4) pH
 - 5) Chloride ion content
- g. Subdrainage requirements, if any

(1 of 3)

Provide factors of safety

h. Parameters for ~~above-ground~~ seismic design:

- 1) Following parameters as defined in 2001 California Building Code (CBC2001)
 - a) Soil Profile type S_A through S_F
 - b) Near source factors N_a and N_v
 - c) Seismic source type A, B or C
 - NN * 2) Site specific response spectra², vertical and horizontal, graph and digital, for 5% damping
- 3) Tunneling and buried structures parameters:
 - a) Direction of earthquake wave with respect to structure
 - b) For each soil layer in contact with structure, furnish for Maximum Design Earthquake (MDE) and for Operating Design Earthquake (ODE):
 - i. Shear wave velocity or effective shear wave velocity for total depth of structure
 - ii. Effective P-wave velocity
 - iii. Effective Rayleigh wave velocities
 - iv. Maximum displacement amplitude of the soil medium
 - v. Modulus of elasticity of the soil medium
 - vi. Poissons ratio of the soil medium
 - vii. Racking deformation based on the structure height and stiffness
 - viii. Peak soil particle acceleration

NL * i. K moduli for floor slab base course and subgrade

j. Plasticity index for soils under slabs and foundations and adjacent to walls.

k. Liquefaction potential and mitigative measures

2. Civil

a. Maximum cut and fill slopes

b. Area subsidence or differential settlement potential which might affect gravity drainage

c. R value of paving underlay Roads & Near Hall Parking Value

* d. Percolation (if required)

e. Ability to use cut material for structural fill. If imported fill is required — source for imported fill

f. Compaction requirements

g. Seismic lateral spreading potential

3. Parameters for below-ground seismic design of FEH ^{and Undulator Hall} cavern:

Following parameters as defined in 2001 California Building Code (CBC2001)

- NN * 1) Soil Profile type S_A through S_F
 2) Near source factors N_a and N
 3) Seismic source type A, B or C
 4) Tunneling and buried structures parameters:
 5) Direction of earthquake wave with respect to structure
 6) For each soil layer in contact with structure, furnish for Maximum Design Earthquake (MDE) and for Operating Design Earthquake (ODE):
 ix. Shear wave velocity or effective shear wave velocity for total depth of structure
 x. Effective P-wave velocity
 xi. Effective Rayleigh wave velocities
 xii. Maximum displacement amplitude of the soil medium
 xiii. Modulus of elasticity of the soil medium
 xiv. Poissons ratio of the soil medium
 xv. Racking deformation based on the structure height and stiffness
 xvi. Peak soil particle acceleration

B. K moduli

C. Plasticity index

D. Liquefaction potential

E. Triaxial testing of undisturbed samples: ^{TWD} Three-drill holes at FEH cavern centerline

¹ for undulator Hall
 (test undisturbed samples 3 each at crown, midpoint and invert level)

1. Provide factor of safety

²To be discussed with Stanford Earthquake Safety Committee

F. Presuremeter test for in-situ deformation modulus at FEH & Undulator Hall

(3 of 3)



**DRILLING NOTIFICATION
ANNUAL GEOTECHNICAL DRILLING PERMIT
ENVIRONMENTAL HEALTH SERVICES DIVISION
SAN MATEO COUNTY DEPARTMENT OF HEALTH SERVICES
455 COUNTY CENTER, REDWOOD CITY 94065
VOICE (650)363-4305 FAX (650)599-1071**

**ALL DRILLING MUST BE SCHEDULED WITH COUNTY STAFF AT LEAST
THREE (3) WORKING DAYS IN ADVANCE**

An accurate & correct map of proposed boring locations must be included with notification Notification is hereby given under Annual Geotechnical Drilling Permit No. 04-0320, with expiration date 2/18/05, that the Consultant Company listed below will be drilling for geotechnical investigation only as described below.

DRILLING WILL BEGIN ON: 03/18/04 NO. OF BORINGS: 6 BORING DESIGNATIONS:

DRILLING LOCATION:
Business Name: Stanford Linear Accelerator Center Assessor's Parcel # A(074480-080,150,240,260,370)
Address: 2575 Sand Hill Road City, State, ZIP: Menlo Park, CA 94025
Borings to be constructed in: Public Sidewalk Roadway Private Property Other
Proposed Depth Borings: 50', 65', 115', 115', 100', 100' Drilling Method: Rotary
Boring Diameter: ~ 4 inches Grout Material: cement

BORING OWNER:
Name: SLAC Contact Person: David Saenz
Address: 2575 Sand Hill Road City, State, ZIP: Menlo Park, CA 94025
Telephone: (650) 926-2512
(Letter signed by boring owner attesting to knowledge of all permit requirements and conditions, may be substituted for signature on permit application.)
Boring Owner's Signature: [Signature]

PROPERTY OWNER (IF DIFFERENT FROM BORING OWNER)
Name: _____ Contact Person: _____
Address: _____ City, State, ZIP: _____
Telephone: _____
I understand that a boring(s) is being installed on my property.
(Letter signed by property owner, containing above language, may be substituted for signature on permit application.)
Property Owner's Signature: _____

DRILLING COMPANY: Taber Consultants
Address: 3911 West Capitol Avenue Contact Person: Andy Taber
City, State, ZIP: West Sacramento, CA 95691 Drillers License #: C57, 466270
Telephone: 916-371-1690
I certify that borings under this notification will be constructed/destroyed in compliance with the conditions of the Annual Geotechnical Drilling Permit listed above, the San Mateo County Ordinance, and the State Water Well Standards, and that the license listed above is considered current and active by the Contractors State License Board.
Driller's Signature: [Signature]

CONSULTANT COMPANY: RUTHERFORD & CHEKENE
Address: 427 THIRTEENTH STREET Project Manager: Gyimah Kasali
City, State, ZIP: OAKLAND, CA 94612 Telephone: (510) 740-3200
Responsible Professional: Gyimah Kasali
I certify that this notification is correct to the best of my knowledge. I certify that the geotechnical borings under this notification will be constructed/destroyed in compliance with the conditions of the Annual Geotechnical Drilling Permit listed above, the San Mateo County Ordinance, and the State Water Well Standards. *(Responsible Professional must be a California Registered Geologist or Civil Engineer.)*
Responsible Professional's Signature: [Signature]
Registered Geologist (RG) or Civil Engineer No.: CE 36686

GPP Staff Approval: _____ Date: _____

Revised July 2002

ORDINANCE: 03101

ENVIRONMENTAL HEALTH
S A N M A T E O C O U N T Y



PERMIT 04-0320

PE: 2013 ³rofes **GEOTECHNICAL** ¹⁰⁰ANNUAL SOIL BORING PERMIT

FACILITY:

S.M. COUNTY 72 HOUR NOTICE

OWNER:

RUTHERFORD & CHEKENE
427 THIRTEENTH ST
OAKLAND

CONTRACTOR:

SR0004398

AMOUNT PAID:

\$435.00

CONSULTANT:

GYMAH KASALI

TERMS & CONDITIONS:

ANNUAL GEOTECHNICAL PERMIT

GREG SMITH

ENVIRONMENTAL HEALTH SPECIALIST

DATE ISSUED: 2/18/2004

EXPIRATION DATE: 5/18/2005

THIS PERMIT IS NONTRANSFERABLE AND MUST BE POSTED ON-SITE IN A CONSPICUOUS PLACE