California NLC Site 90

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NLC Conventional Facilities
Next Linear Collider – U.S. Collaboration

California NLC Site 90

San Louis Reservoir

I-205/I-5

Site 90
PHOTO 2. View southwest toward the rolling hills of southern Site 90S. The hills in the foreground are underlain by gently dipping Tertiary sandstone (Ts) and claystone (Tc) beds. The California Aqueduct flows from right to left (north to south) in cut through the Tertiary rock and fill across the Quaternary alluvium (Q). The higher mountains in the background are underlain by Cretaceous rocks (Ks and Kc) separated from the more distant Cretaceous and Jurassic Franciscan Complex rock (KJ) by the Tesla-Ortigalita fault. The San Joaquin fault separates the rolling hills in the foreground from the San Joaquin Valley just behind the viewer.
Currently 3 proposed California Sites

- Site 135 - Cut & Cover
- Site 127 - Bored Tunnels
- Site 90 - Bored Tunnels
Primary facility needs

- Close proximity to existing DOE Lab(s)
- Sensitive to micro-seismic motion & vibration
  - minimal tolerance for ground motion
due to cultural/natural vibration sources
- Availability of ~300 MW of power
- Availability of ~10 acre-ft/day of water
- Availability of Lands
  ~3,600 acres - 0.5 Km x 32 Km
  ~300,000 sq.ft. campus surface buildings
Primary facility needs (continued)

- Competent bedrock - uniform geology for tunneling purposes, quiet, structurally stable
- Reasonable accessibility - at IP and e+e- damping rings, main linacs, etc.
- Proximity to regional infrastructure
  (i.e., roads, railways, airports, educational institutions, labor supply)
- Other regional resources
  (i.e., social, cultural, recreational, housing & accommodations, health care, emergency services)
Site Attribute Weighting

**Very High (4)**
- Geology
- Hydrogeology
- Long Term Stability
- Micro-Seismic Motion & Vibration
- Electrical Power
- Water Supply

**High (3)**
- Proximity to DOE Lab
- Land Availability
- Topography
- Seismicity
- Environmental Impacts
Site Attribute Weighting

**Medium (2)**
- Soil
- Climate & Weather
- Regional Infrastructure
- Regional Resources
- Community Attitude

**Low (1)**
- Fuel
- Telecom
- Wastewater Treatment
- Solid Waste Disposal
- Rail Access
- Seaport Access
**Site 90**

**Bored Tunnels w/ Lateral Accesses**

- SLAC
- LLNL
- LBNL
- UCD
Typical Site Seismicity in Western Slope of the Central Valley

- 25 Year Peak Horizontal Motion ~ 0.3g
- 1 Year Peak Horizontal Motion ~ 0.08g
- Active Near Fault Slip Rate 1.5 mm/yr 7 km Away
- With +/- 1.5mm Magnet Mover Control Range
- Adequate & Acceptable for 9 Month Physics Runs
## Table 4. Variation of Significant Geologic Factors Among the Representative NLC Sites

| Geologic Survey | Geologic Units | Quaternary deposits (Q) | Tertiary sandstones (Ts) | Tertiary claystones (Tc) | Cretaceous sandstones (Ks) | Cretaceous claystones (Kc) | Strike of bedding | Tertiary strata (total degrees) | Cretaceous strata (total degrees) | Dip of bedding | Tertiary strata | Cretaceous strata | Mapped faults crossing alignment | Quaternary active | Pre-Quaternary | Active faults within 100 km | Nearest active fault | Slip rate | Peak horizontal ground motion (10% probability of exceedence) |
|-----------------|----------------|-------------------------|--------------------------|-------------------------|----------------------------|----------------------------|-------------------------|-----------------------------|-------------------------------|-----------------------------|----------------|----------------|----------------|--------------------------------|----------------|---------------|-----------------------------|-----------------|-------------|--------------------------|
| Site 150        | Minimum elevation | 280 ft                  | 180 ft                    | 240 ft                  | 820 ft                     | 820 ft                     | N10W to N15E (20) | N10W to N3E (13)            | N120W to N60W (60)             | 5 to 20 E (15)  | 40 to 70E (30)  | 40 to 70E (20)   | 6 pre-Quaternary (3)         | 1 pre-Quaternary | 12            | 7.5 km (G V thrust)        | 1.5 mm/yr        | 0.019 to 0.024 g  |
| Site 135        | Maximum elevation | 500 ft                  | 1140 ft                   | 1060 ft                 | 890 ft                     | 840 ft                     | N10W to N3E (13) | N40W to N60W (20)            | N10W to N50W (40)             | 5 to 50 NE (45) | 205W to 70NE (90) | 30 to 70NE (40)  | 6 pre-Quaternary (15)        | 1 pre-Quaternary | 30            | 7.3 km (G V thrust)        | 1.5 mm/yr        | 0.024 to 0.046 g  |
| Site 90N        | Relief           | 220 ft                  | 960 ft                    | 640 ft                  | 650 ft                     | N10W to N3E (13)           | N40W to N60W (20) | N10W to N50W (40)             | 5 to 30E (40)    | 205W to 70NE (90) | 30 to 70NE (40)  | 1 pre-Quaternary (30)        | 1 pre-Quaternary | 30            | 7.8 km (G V thrust)        | 1.5 mm/yr        | 0.008 to 0.105 g  |
| Site 90S        | Minimum elevation | 280 ft                  | 180 ft                    | 240 ft                  | 820 ft                     | 820 ft                     | N120W to N60W (60) | N120W to N60W (60)            | N120W to N60W (60)             | 5 to 20 E (15)  | 40 to 70E (30)  | 40 to 70E (20)   | 6 pre-Quaternary (3)         | 1 pre-Quaternary | 12            | 7.5 km (G V thrust)        | 1.5 mm/yr        | 0.019 to 0.024 g  |

### Reference Materials

- **Existing mapping**
  - Bedrock: 1:12,000 to 1:48,000, 1:19,000 to 1:48,000, 1:24,000, 1:24,000 to 1:62,500
  - Quaternary: 1:62,500, 1:62,500, 1:24,000, 1:24,000
  - Scales: 1:20,000 to 1:40,000, 1:20,000 to 1:40,000, 1:20,000 to 1:40,000, 1:23,715 to 1:40,000

### Other Considerations

- Sites-Colusa Project, Sites-Colusa Project, Coast Range Tunnel
Sources of Electric Power

- Existing 230 kV Power Transmission Lines south of Tesla Substation and north of San Louis Reservoir
Sources of Water

- California Aqueduct system
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SLAC – FNAL – LBNL – LLNL

California Site 90

Site 90

LLNL Site 300

1 of N - Aarons 09.06.02
Site 90 Alignment

facing west

San Louis Reservoir

LLNL Site 300

Scale:
1 Horiz.
4 Vert.
Site 90 Geology / Hydrogeology

- Cretaceous sandstones with interbedded siltstone/claystone
- Well cemented/competent rock
- Self supporting
- Good for TBM
- Regional ground water > 300 ft below tunnel alignment
Site 90 Alignment

* notional - 1st cut w/o field work to support
Land Ownership

• Primarily agricultural lands - cattle grazing

• 90 Alignment - Stanislaus and Merced Counties - 60% privately owned property

(Nature Conservancy Corporation owns ~40%)
Real Estate Values in CA Central Valley

- Site 90 area - 3,600 acres at ~$1,000 per acre
  = $3.6 M (fee simple)

- Cost between $200-$800/acre for rangeland
  (CA Farm Bureau, 2001)

- DOE - US Bureau of Land Management leases back rangeland to same ranchers
Current Plans –

• Identify potential locations for IP - take seismic measurements

• Dither alignment for optimum access points
  - for cost optimization
Current Plans (continued)

Detailed Site Characterization & Environmental Studies

• Geology - rock properties, bedding orientation, fractures, folds, faults

• Hydrology, groundwater, water rights

• NEPA - Preliminary Environmental Evaluation
  - cultural, historic or archeological resources
  - threatened or endangered species, habitats
  - Cumulative environmental affects and effects
NEPA Compliance

• Assessment of all environmental impacts for planned and foreseeable projects
• Evaluate proposed action and alternative action(s)
• Recommended preferred action
• Description of existing conditions
• Description of impacts due to preferred actions
THE END
Task is to design, build and operate a facility (NLC) with a footprint of about 32 km long and 0.5 km wide - including IP halls, each size a football field.

**General layout**
- Injectors produce electron and positron beams
- Linac accelerates the beams to 500GeV energy
- Final focus focuses beams to a tiny spot in a collision point
- Detector detects products of collisions and determine their properties
**Ground Motion Tolerance**

- NLC will collide beams (swarm) of electrons and positrons
- To increase probability of direct collisions of $e^+e^-$, beam sizes must be very small
- NLC beam sizes just before collision; \(200 \times 2 \times 100000\) nanometers (\(x\ y\ z\))

  Vertical size (\(y\)) is smallest (2nm)

- Ground Motion and imported vibrations continuously misalign components of a collider and can result in
  - Off-set at IP
  - Emittance growth
• **Goal:**
  To achieve stability of within a few nanometer above a few Hertz at the most critical region (Interaction Point).

• **Perspective:**
  Figure below, shows range of natural and man-made vibration.
Ground Motion At Different Sites

- Ground motion at NLC site is a primary concern
- Cultural Noise and Geology are very important
- Motion is small at high frequencies
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California Site 90

Freight Rail Network

Shortline Network

Class 1 Railroad System Map

Freight Rail Network
- BNSF
- UP
- Other *

* Freight service provided by BNSF or UP under Trackage Rights Agreement

Regional and Short Line Railroad System Map
Geology of Site 90 - northern portion

- Mostly sandstone
- Mostly shale or claystone
- Mostly sandstone
Geology of Site 90 southern portion

- Mostly sandstone
- Mostly shale or claystone
- Mostly sandstone
Site 90 Alignment

California Site 90