

I. LIGO SITE SELECTION CRITERIA

A. Science Impact

(These criteria are discussed in Volume 1, Sections IV and V.C in the proposal: “A Laser Interferometer Gravitational-Wave Observatory (LIGO),” submitted to NSF December 1989.)

1. Local Parameters
 - a. Site topography affecting LIGO facility critical parameters (angle between arms, arm length, slope of L-geometry beam tubes).
 - b. Natural and man-made ground vibration spectra.
2. Global Parameters
 - a. The requirement for two sites.
 - b. Distance between sites.
 - c. Relative alignments of L-geometries of paired sites.
 - d. Area factors of site triplets: Two U.S. sites and one European site.

B. Construction Cost Impact

1. Topography (required earth movement)
2. Soil and subsurface conditions
3. Hydrology and drainage
4. Climate
5. Environmental restrictions
6. Accessibility (roads, rail, etc.)
7. Site utilities installation (power, water, sewage, etc.)
8. Proximity of soil waste and borrow areas
9. Local labor costs

C. Site Availability and Acquisition Costs

D. Existing Support Infrastructure

1. Accommodations for resident staff (housing, schools, shopping, etc.)
2. Accommodations for visiting staff (hotels, transportation, etc.)
3. Local technical support (vendors, maintenance, fabrication, etc.)

E. Operations Cost Impact

1. Cost of power
2. Cost of local labor
3. Heating and cooling requirements
4. Maintenance requirements
5. Travel time and costs for visiting staff

F. Risk Factors

1. Environmental risks (earthquakes, floods, windstorms)
2. Potential future man-made noise from development

G. Security of Facility and Access for Visiting Staff

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II. LIGO SITE SELECTION PROCESS

- A. Place LIGO Site Competition Announcement (III) with Commerce and Business Daily (90 day response time).⁽¹⁾
- B. At the end of the solicitation interval (90 days), evaluate all site candidates for technical suitability according to the *I. LIGO Site Selection Criteria, Sections B through G*. Document these analyses.
- C. Sort technically suitable sites into compatible site pairs, using *I. Site Selection Criteria, Section A*, and document.
- D. Rank order site pairs based on *Site Selection Criteria* (see II.B, C above). Judgment will be based on documented analysis.
- E. Submit rank-ordered list of site pairs to NSF for approval.
- F. Continue technical characterization, address environmental issues and negotiate transfer to LIGO project of the top ranked site pair.
If negotiations unsuccessful, open discussions with next ranked pair.
- G. Submit analysis and final recommendation for site pair to NSF for approval.

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III. LIGO SITE COMPETITION ANNOUNCEMENT

The National Science Board (NSB) has approved a proposal by scientists of the California Institute of Technology (Caltech) and the Massachusetts Institute of Technology (MIT) to develop and construct a Laser Interferometer Gravitational-Wave Observatory (LIGO). Construction and operation of LIGO are expected to be funded by the National Science Foundation (NSF). Estimated construction costs for LIGO of \$192M over a 4-year period are contained in the President's FY '91 budget proposal, and are presently under review by Congress.

LIGO will consist of two widely separated gravitational-wave detector facilities in the continental United States. Each facility includes an L-shaped vacuum system, with arms

⁽¹⁾ Groups that already have provided site information to the LIGO project will be offered an opportunity to make additional inputs.

of 2.5 miles length, consisting of 4-foot diameter evacuated steel pipes with access ports, containing laser interferometric sensor systems. Located at the vertex of the two arms, and at the midpoint and outer end of each arm, are buildings housing the access ports to the vacuum system. These buildings are interconnected by a semi-cylindrical reinforced-concrete vault enclosure, which protects the vacuum pipes containing the measurement laser beams. The vacuum pipes must provide for straight optical paths along the full 2.5 mi length of each arm.

The NSB has authorized the LIGO project to conduct a public search for two suitable sites in the U.S. to accommodate the LIGO facilities, and proposals from interested parties are invited.

Principal requirements of individual sites are as follows:

- _The site must allow the construction of a flat L-shaped foundation slab, 20 feet wide and 2.5 mi long on each arm, which supports the vacuum pipe and its concrete-arch semi-cylindrical enclosure. Foundations for the vertex building, the two midpoint buildings and the two end buildings along each arm will lie in the same plane as the pipe support foundation. The elevation change between the vertex building foundation and either end building foundation may not exceed 40 feet.
- _The site must permit construction of the five major buildings and ancillary structures. The vertex building is 80,000 sq. ft. in area and the midpoint and end buildings are 6500 sq. ft. each. All are 55 feet high above the foundation plane.
- _The layout must avoid earthquake fault lines, floodplains, wetlands, and should minimize road or waterway crossings.
- _The site requires road access for construction and for operation.
- _The site must be able to accommodate a service road adjacent to the 2.5 mi x 2.5 mi system to provide access to entry points along the pipeline and to the five buildings.
- _The site requires a power hookup with a minimum capacity of 1 MW, delivered to the vertex building.
- _The site requires water supply and waste disposal facilities sufficient for sanitary needs of permanent staff and visitors (20–30 people).
- _The site must have geotechnical features that provide good drainage characteristics and soil properties to assure a minimum of foundation settlement (less than 1 inch) after construction. Maximum building foundation load will be 2000 lb. per sq. ft.
- _The LIGO site must be remote from sources of man-made noise, but within convenient commuting distance of housing, schools, and shopping for its resident staff.
- _Costs to be paid by the LIGO Project for all site preparation work required to provide a suitable graded base for foundations and roads (including provisions for drainage and erosion control), and utility connections (power, water, sewer, telephone) may not exceed the budgeted cost of \$2,500,000.

Construction start for the LIGO facilities is proposed for FY '91 and is expected to take 4 years. LIGO will be developed, built, and operated by Caltech and MIT for the scientific community. Occupancy will include a permanent local staff of about 10–20 people, and about 10 visiting scientists.

LIGO is an environmentally benign facility and generates no industrial pollutants.

Interested parties are invited to submit a letter of intent, including

1. A map of the proposed location of the LIGO site(s).
2. A topographic map (USGS 7.5 minute series, original color copies) with a sketch of the proposed layout(s) for LIGO facilities (2.5 mi x 2.5 mi, L-shaped). (Attach sketches of the elevation profile along each of the 2.5 mi long arms.)
3. Readily available geotechnical data that may be useful in evaluation of site potential.
4. Available data on climate (temperature, wind, precipitation).
5. A description of present land use of the site.
6. A description of the proposed access for utilities and transportation.
7. A statement describing land to be provided at no or nominal cost to the LIGO project, and how and by whom this arrangement will be secured.
8. A discussion of potential future urban or commercial development that may encroach upon LIGO.
9. A statement on expected environmental or procedural issues which may affect a timely construction start.
10. A commitment to provide additional geotechnical data needed for construction if the site should be selected for further evaluation.
11. A statement describing any additional support the applicant is prepared to provide.

These initial submissions will be individually evaluated for their technical feasibility. Subsequently, sites will be paired, based upon scientific requirements including separation and orientation. Additional investigations of these pairs may be conducted, in order of ranking. Final analyses and recommendations will be submitted to the NSF for selection. The LIGO Project may also consider sites other than those resulting from this solicitation.

The letter of intent (5 copies) is to be submitted to:

LIGO Project
California Institute of Technology 102-33
Pasadena, CA 91125

Deadline: (90 days after publication of solicitation)

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