



*LIGO Laboratory / LIGO Scientific Collaboration*

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PSL Laser Area Enclosure specifications and requirements  
for the procurement RFP

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## 1 Introduction

Three Laser Area Enclosures (LAE) will be constructed inside the high-bay, Class 50,000, Laser and Vacuum Equipment Areas (LVEA), two at the LIGO Hanford Observatory (LHO) in Richland, WA and one at the LIGO Livingston Observatory (LLO) in Livingston, LA. Each LAE will have three principal components – the Laser Room, the Ante-room, and the Air Shower. The sizes and configuration of the components are shown in the attached sketch.

## 2 Modes of operation

Each LAE will have two modes of operation *Service Mode* during which the rooms may be occupied and all equipment such as HEPA blower units are allowed to operate, and *Science Mode*, during which no local fans are allowed to be energized. In Science Mode, some make up air may be ducted into the Laser Room and/or Ante-room to maintain overpressure and temperature control. Particulate counts should remain below detectable levels when operating in Science Mode.

## 3 Features

- 1) Laser room interior dimensions: 23 ft x 15 ft with minimum ceiling height of 9 ft
- 2) Ante-room interior dimensions: 11 ft. 6 in. x 18 ft. 4 in. with minimum ceiling height of 9 ft.  
High-velocity, filtered and re-circulated air shower with minimum interior dimensions of approximately 3 ft. x 4 ft.
- 3) Cleanroom-grade double-door access to Ante-room with two 3 ft. wide leaves. The plan northernmost leaf is normally inactive with the southernmost leaf normally active. The doors swing out from the Ante-room to the LVEA. Door hardware only permits opening the doors from inside the Ante-room.
- 4) Cleanroom-grade double-door access between Ante-room and Laser Room with two 3 ft. wide leaves. The plan westernmost leaf is normally inactive with the easternmost leaf normally active. The doors open into the Ante-room.
- 5) Windows in each of the leaves of the double doors between the Ante-room and the Laser Room.
- 6) Large viewing window, approx. 6 ft. wide x 4 ft. high, in wall separating Ante-room from Laser Room.
- 7) Lever-style door handles in all locations.
- 8) 1000 lux LED lighting in both the Laser Room and Ante-room with capability to vary light levels either by dimmers or multiple switchable circuits. Lights wired to junction box located on the roof or one of the walls of the LAE. AC power connection to be provided by LIGO.
- 9) Switches for Laser Room lights on both sides of the plan south wall of the Laser Room, just to the east of the double doors, i.e. the Laser Room lights can be controlled from the Ante-room. Rocker-style light switches or dimmers in all locations.

- 10) Through-wall ducting consisting of 6' diameter PVC pipes embedded in the cleanroom walls and extending approx. 1" beyond both the inner and outer surfaces of the walls. The ducts are to be located as follows:
  - a) 2 ea. side by side at floor level penetrating the plan north wall of the Laser Room approx. 67 in. from the northeast inside corner of the Laser Room.
  - b) 1 ea. penetrating the plan south wall of the laser room approx. 18" above floor level and flush with the plan west wall of the Laser Room.
  - c) 1 ea. penetrating the plan south wall of the laser room approx. 18" above floor level and flush with the plan east wall of the Laser Room.
  - d) 1 ea. penetrating the plan north wall of the Ante-room approx. 18" above floor level and flush with the outside of the plan west wall of the Laser Room.
  - e) 2 ea. at floor level penetrating the plan west wall of the Laser Room approx. 97" from the northwest interior corner of the room.
- 11) 120V duplex electrical outlets (general purpose spec. grade 20A) located approx. 18" above floor level and at approx. 6 ft. intervals along the interior Laser Room walls and all but the plan south interior wall of the Ante-room where cabinets will be located.
- 12) Variable-flow HEPA fan units capable of control from both the Ante-room and a remote location (the observatory control room). Control room control to be installed by LIGO.
- 13) Flush mounted junction boxes with conduits running up to the roof of the LAE should be installed approx. 12" below ceiling level in the center of the plan north and south walls of the Laser Room and in the center of the plan west and east walls of the Ante-room. These will be use for surveillance cameras.
- 14) Cleanroom compatible speakers in both the Laser Room and Ante-room capable of operation with intercom (provided by LIGO) and LIGO facility fire alarm system.

## 4 Performance

1. Class 1000 working conditions in both Laser Room and Ante-room when in Service Mode.
2. Laser Room has most stringent cleanliness requirements which may dictate that it maintains overpressure with respect to Ante-room.
3. 20 dB of acoustic attenuation from LVEA to Laser Room for acoustic frequencies above 100 Hz when operating in Science Mode
4. Laser Room temperature variations less than plus or minus 1 deg. C, including during transition from Science Mode to Service Mode and vice versa. Note that the estimated maximum heat load in the Laser Room when in Science Mode is 300 W. The temperature of the LVEA is maintained at approximately 20 deg. C with variations of less than plus and minus 1 deg. C. The maximum expected occupancy during Service Mode operation is five people.

## 5 Design considerations

1. It may be desirable to concentrate the flow of HEPA filtered air over the laser table in the Laser Room. Maintaining cleanliness of the optical components on and above the table surface is the principal goal of the LAE. The surface of the 5 ft. x 16 ft. x 2 ft. thick optical table will be 40" above the floor of the Laser Room.
2. Pre-fabrication of as much of the LAE as possible may be desirable for control of particulate contamination during construction inside the LVEA and to minimize construction time inside the LVEA. The LVEA can be accessed via a roll-up door approximately 15 ft. wide and 25 ft. high. Overhead bridge cranes with 5 ton capacities and hook heights of 26 ft. service the LVEA and could be used to transport pre-fabricated sections of the LAE.
3. To maintain cleanliness, significant construction activities carried out inside the LVEA, will likely require installation of temporary barriers of plastic sheeting and working with vacuum cleaners with exhausts ducted to the outside or clean room vacuum cleaners.
4. It is preferable that HEPA fan units operate on 277 V mains power.
5. It may be desirable to duct HEPA filtered make-up air into the Laser Room and Ante-room, particularly during Science Mode operation. The associated fans and compressors, if required, would have to be located approximately 50 to 100 ft. from the LAE.
6. Double-layer sheetrock construction with separate and staggered studs for the interior and exterior walls of the Laser Room may be desirable for acoustic attenuation and may prove beneficial for forming a return air plenum for HEPA filtered air.
7. Cleanroom compatible acoustic dampers mounted to the interior walls of the Laser Room may be desirable to achieve the required levels of acoustic attenuation.