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LIGO STAGING BUILDING MODIFICATIONS FOR CONVERSION TO A CLEAN ROOM FACILITY

Background

The Shop/Support Building at the LIGO Hanford Observatory was constructed in 1998 and is a 7,600 square foot steel structure with a 2,500 square foot assembly area. The facility has airlocks at all exterior doors with one exception. The mechanical systems include a small split system serving the office area, and a packaged heat pump, 12 ton nominal capacity, serving the balance of the building.

Project Purpose

The project intent is to establish a clean room area for assembly of components for the LIGO Observatory. The working areas must be pressurized with HEPA filtered air, with room air pressure cascading to the surrounding rooms and the outdoors to prevent infiltration of outside air.

Findings

1. The building has air locks at all doors with the exception of the assembly room door to the outside. This door will require an airlock.

2. The filtration equipment and the supply duct connecting to it must be isolated from the clean area and located in an area with an air pressure less than the clean area air pressure. A portion of the Mezzanine area designated on the drawings will require an isolation wall and door.

3. The main entrance airlock has air supplied to it that transfers back to the assembly area through a transfer grille. This supply air overrides the capability to cascade the air pressure from the assembly area, to the airlock, and creates a contamination potential, as airlock air will flow to the assembly room. The supply air to this airlock will need to be eliminated.

4. The office area needs to be a clean area. The existing split system AC unit draws air from the outside. This system should be eliminated and all building air supplied through the filtering system so that filtered air and pressure relationships can be maintained.

5. Supply air ducts located in the mezzanine level workroom (northwest corner) need to be re-connected to deliver air to the assembly bay.

6. The heat pump system currently installed does not deliver the flow rate indicated on the drawings. The heating and cooling capacity match the building requirements. The system lacks the fan capacity to supply full flow (5000 cfm) through the proposed filters in a fully loaded dirty filter condition. Upgrading the motor to a 7.5 HP motor and changing the drive pulleys will yield sufficient fan capacity for operation with HEPA filters. This will require upgraded electrical service to the unit. This upgraded arrangement will not have the static capacity for fully loaded filters.

7. Trench drains should be covered to eliminate the potential for airflow into the space through the drains, and to keep the area cleaner.

8. Existing exhaust fan in the assembly room should be eliminated and the penetration sealed.

Proposed Solution

The modified design as shown is proposed to attain a clean room (MERV 17) environment using HEPA filters with 99.97%efficiency on 0.3micron size particles (IEST Type A). The proposed system will function with the system and building modifications as listed in the design drawings.

The design major activities include:
Construct an airlock at the Assembly Area exterior door.
Construct an enclosure wall at the mechanical equipment area on the Mezzanine Level.
Modify ductwork and install the filter housing on the Mezzanine Level.
Remove the existing office split system air conditioner.
Upgrade the Air Handler fan capacity with a fan motor and sheave change.
Modify/add ductwork for return air from the Assembly Area and Mezzanine.
Remove the air supply to the large airlock.
Re-connect ductwork in the Mezzanine Workroom.

Limitations with the proposed system are associated with the system fan capacity. With a motor and sheave upgrade, the system will not take the filters to their fully loaded condition. To achieve full fan capability, a new air handling unit or an added "booster" fan would be required. To function within the budget limitations of the project, the latter would be recommended.

The addition of a floor mounted centrifugal fan, at the outlet of the filter housing, and associated electrical work is listed as an option in the estimate.

Cost Estimate

Costs are summarized in the attached spreadsheet. The total for the proposed changes is estimated at $xxxxx. The booster fan addition adds about $xxxx to the cost. Engineering costs for detail design and specifications are not included in the estimate.