BEAM SWITCHYARD VENTILATION STUDY

REPORT TO STANFORD LINEAR ACCELERATOR CENTER - ABA NO. 93

STANFORD UNIVERSITY SUBCONTRACT S-136

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INTRODUCTION

This report presents a plan for ventilating the Beam Switchyard and includes sketches showing several alternate methods for filtering the exhaust air. Rough costs of the methods are listed on the sketches. Also included is a discussion of the efficiency of the filters. The degree of exhaust air cleanliness required must be determined by SLAC and included in the criteria for the design of the facility.

GENERAL PLAN

The ventilation plan for the beam switchyard provides a system of four exhaust fans with capacity to change the air in the underground structure at the rate of six changes per hour. The air will enter the switchyard through the tool car entranceway where the air will be filtered. The tool car entrance is the principal access to the beam switchyard and it is desirable to have the air enter at that point. Normally, closed heavy concrete doors at the tool car entrance will be opened when the exhaust fans are running. The air then flows two ways, some toward the Accelerator Housing, but principally toward the Target Area. Air will be supplied to both upper and lower levels.

Most of the exhaust air will be drawn from the lower level so as to tend to keep it at a slight negative pressure, relative to the top level, during the purge operation. Exhaust fans are located so as to draw air through the underground structure and through each of the beam passageways. Ducts leading to the fans take air from as near to the end of the passageways as feasible, with an additional branch to the beam dump area. At the magnet area, near to the tool car entrance, an exhaust system is provided to draw air from the lower level only. Exhaust ducts will be labyrinth type and will incorporate automatic closing devices to prevent air flow when fans are not operating.

Air may be monitored at the exhaust shaft. Airtight partitions between the beam switchyard, and the end stations and the Accelerator Housing, will prevent air migration into the beam switchyard from those areas.

INLET FILTERS

The air inlet filter panels are one-inch thick filter media held in hinged metal frames and are located on the switchyard side of the heavy concrete doors. The filter media is the low velocity replaceable type and is supplied in rolls for cutting to the required length. It will be the same as that provided for filtering the purge air for the Accelerator Housing, and as planned for the End Station air inlets. The frames will also be similar to those provided at the accelerator inlet structures.

EXHAUST FANS

Fans will be two-speed, tube-axial propeller type, which are the least expensive for the service. They are quite noisy at high speed but should be satisfactory since they are remotely located. The high speed will be used infrequently and for short periods. They will discharge vertically at a velocity of about 2000 fpm when operated at high speed. Low speed will be used for ventilation while work is in progress in the Switchyard.

DISCUSSION

Twelve sketches are included in this report. Sketch SK-M-110, AIR FLOW DIAGRAM, shows the method for obtaining the desired air flow. Sketch SK-M-111, AIR INLET PLAN, shows how the air will be introduced through the Tool Car Entrance. Sketches SK-M-112 and SK-M-113 show the duct arrangement at End Station, and these sketches also illustrate the proposed exhaust arrangement for Beam A, and future Beam A-1 at End Station A. A branch will be provided for exhausting the air in the vicinity of the beam

dump on Lane A. A similar arrangement is proposed for combining the exhaust from Beams B, C, and the Gamma Beam, and discharging the air at a point near End Station B. A third exhaust station, similar to the exhaust stations serving the Accelerator Housing, is located near the end of the Accelerator Housing, Station 101+00. The fourth fan is near the tool car entrance at Station 108+00. This exhaust station will draw air only from the magnet area in the lower level. SK-M-115 shows how this fan may be installed.

The exhaust vents will be designed so that they incorporate built-in shielding or so that they may be readily covered with additional shielding if that proves necessary. Sketches SK-M-114 and SK-M-115 illustrate labyrinth type built-in shielding near grade. Additional labyrinth arrangements may be provided just above the switchyard ceiling if necessary. SK-M-116 illustrates a similar arrangement with the addition of prefilters and absolute filters for cleaning dust from the air. Dust of 0.3 micron particle size and larger can be effectively removed by this method. Lower cost filter types may be used, in similar arrangements if lower efficiencies are acceptable. SK-M-117 through SK-M-121 show various exhaust schemes, using the same type of fan but incorporating different fan arrangements and providing for several different types of filters including (1) low pressure filters; (2) capillary air washer type; and (3) high efficiency filters. Any of these could be installed below grade similar to the arrangement shown in SK-M-116 if desired. The air washer would require additional water supply, pump, and drainage facilities.

COSTS

Costs for various arrangements of the fan and for several types of filters have been estimated for the largest fan system. The costs for each arrangement show on the sketch that illustrates the method. The figures shown are comparable but do not include all the costs which must be included in the budget figures.

Cost Comparison for Various Filter Systems (1)

Approximate Fan Location	Reference Sketch SK-M-	Approximate Cost (1)
I Unfiltered Exhaust		
a. Sta. 100+88	117	Base
b. Sta. 108+00	117	Base
c. Near End Sta. A	112, 113	Base
d. Near End Sta. B	112, 113	Base
		Base
II Unfiltered Exhaust, removable elbow (for shielding and future addition to filters)		
a. Sta. 100+88	118	$ 1,000
b. Sta. 108+00	118	300
c. Near End Sta. A	112, 118	1,800
d. Near End Sta. B	112, 118	1,800
		$ 4,900
III Low Pressure Filter, removable elbow (for shielding)		
a. Sta. 100+88	119	$ 2,000
b. Sta. 108+00	119	600
c. Near End Sta. A	112, 119	3,700
d. Near End Sta. B	112, 119	3,700
		$10,000
IV High Efficiency Filter, removable elbow (for shielding)		
a. Sta. 100+88	121	$ 3,000
b. Sta. 108+00	121	1,000
c. Near End Sta. A	112, 121	5,600
d. Near End Sta. B	112, 121	5,600
		$15,200
V Absolute Filters with below grade vault-type labyrinth and plenum		
a. Sta. 100+88	116	$ 8,000
b. Sta. 108+00	116	3,000
c. Near End Sta. A	112, 116	11,500
d. Near End Sta. B	112, 116	11,500
		$34,000

Note:

(1) Costs are for comparative purposes only, i.e., System II costs $4,900 more than System I.
(2) Additional combinations of filters and fan installations can be evaluated from the above cost figures.

FILTER EFFICIENCY

Efficiencies given for filters are misleading unless the method of test is given. Low pressure filters are usually rated in accordance with the U.S. Bureau of Standards Test Method on Atmospheric Dust. Absolute filters are rated using the dust spot method with smoke particles averaging 0.3 microns in size. High efficiency filters are rated using special graded dusts. There is no correlation between test results. Dry, low pressure-drop type filters trap most of the particles down to 10 microns in size, and some of the smaller particles. On atmospheric dust they are between 10% and 30% efficient on a weight basis. The air washer and high efficiency filters have about the same efficiency, given as 90% to 95% on a weight basis. On atmospheric dust they will probably trap 95% of the particles above 5 micron size and about 50% of the 1 micron particles. Absolute filters will trap all particles of one micron size and 99.97% of the 0.3 micron size. The plenum size for the high efficiency filters is about the same as for the absolute filters shown in Sketch SK-M-116. The filters are about $800.00 less and the fan about $60.00 less. Replacement costs for high efficiency filters is much less than for absolute filters because they hold more dirt and so have at least twice the life.