STATE OF MARYLAND - - DEPARTMENT OF THE ENVIRONMENT

FACSIMILE COVER SHEET

TO: NAME, John White DATE 5/23/89

ORGANIZATION U.S. Nuclear Regulatory Commission

NUMBER OF PAGES 11 PLUS COVER SHEET

NAME OF SENDER Ray Manley

FROM: EMERGENCY RESPONSE
2500 BROENING HIGHWAY

FAX NUMBER (301) 631-3932
TELEPHONE (301) 631-3868

For your review.

A/23

Morton and Potter
10421 MASTERS TERRACE
POTOMAC, MARYLAND 20854

HENRY W. MORTON
10421 MASTERS TERRACE
POTOMAC, MARYLAND 20854
301-983-0365

THOMAS E. POTTER
4231 JENIFER STREET, N.W.
WASHINGTON, D.C. 20015
202-363-4727

5/17/89

Mr. Jackson Ransohoff
Neutron Products, Inc.
Dickerson, MD 20842

Dear Mr. Ransohoff:

Enclosed is a report describing my evaluation of the NPI hot cell ventilations system. This report is intended to respond to condition 13.C.6 of your license issued by the State of Maryland. Please call if you have any questions.

Sincerely,

Thomas E. Potter

Thomas E. Potter

EVALUATION OF THE NPI HOT CELL VENTILATION SYSTEM

Thomas E. Potter

Thomas E. Potter

Morton and Potter
10421 Masters Terrace
Potomac, MD 20854

5/17/89

INTRODUCTION

This report is in response to condition 13.C.6 of the NPI license issued by the State of Maryland for cobalt operations. That condition requires a comprehensive evaluation of the hot cell ventilation system. This evaluation focuses on three aspects of the system--general design, effluent monitoring, and impacts from accidents.

In summary, the general design is considered to be adequate. The effluent monitoring has been sufficient to show that releases have been low and is being improved to permit quantification with greater confidence. Finally, the impacts from accidents are shown to be small.

GENERAL DESIGN

The NPI hot cell ventilation system discharges all of the air drawn into the hot cell and essentially all of the air drawn into the pool area. The system is equipped with two primary HEPA filters in parallel (one normally in use, the other used during change of the first) followed by a secondary HEPA filter. A roughing filter located in the hot cell minimizes the rate of particle loading on the primary HEPA filter. The primary HEPA filter presently in use has been in service for approximately 17 months. The current pressure difference across the primary filter, about 0.5 inches of water, is within the range of expected values for existing flow conditions.

The hot cell ventilation system draws approximately 800 SCFM, as determined by recent NPI engineering measurements on May 3 (memo from F. Schwoerer dated 5/16/89, copy attached). This provides a linear flow rate of approximately 40 lfpm across the open cell door. This flow rate should be adequate to prevent significant releases of airborne materials from the cell during operations with encapsulated cobalt, since contamination levels in the cell are low in the relative sense and operations with encapsulated cobalt are not likely to add contamination to the cell. The flow rate may be adequate for operation with unencapsulated cobalt as well, but data obtained during operations with encapsulated cobalt should be used in making that determination.

The large-area door from the courtyard to the hot cell access room is required to move equipment in and out. If this door is open when the cell door is open, it is possible (however unlikely) that transient pressure drops caused by wind flow patterns could cause a backdraft of contaminated air from the cell. This can and should be prevented by keeping the cell door closed when the large area door is open.

EFFLUENT MONITORING

Procedures and practices for effluent air monitoring have been reviewed. The previous practice of using a low-efficiency full cross-section filter to collect contamination in effluent air is unusual and may or may not be adequate. But the low contamination levels on the filter are reasonable indication that release quantities through this pathway have been small. The fact that contamination levels are low on the roof and on walls near the downward directed discharge point is strong evidence that releases have been low.

I have recommended and NPI has purchased a continuous sampler that will draw secondary HEPA effluent air from the exhaust duct through a high-efficiency (glass fiber or equivalent) filter paper at an appropriate velocity for representative sampling (ie., isokinetic flow) and at an appropriate flow rate for detecting a few percent of MPC for a 24-hour sampling period. All components are on hand except for the sampling tube, which will be fabricated by NPI. NPI engineering has completed a velocity profile measurement across the cross-section of the duct at the most appropriate sampling location (memo from F. Schwoerer dated 5/16/89). Although the system installation is nearly complete, the system may not be operational prior to operations with encapsulated cobalt. If not, an interim alternate method using a Staplex high-volume sampler for continuous sampling at the duct discharge point would be acceptable. Samples from the permanent system should be collected approximately daily when hot cell operations are being performed, and weekly otherwise.

ACCIDENT ANALYSIS

The inventory of cobalt-60 on the filters can be estimated from radiation measurements in the fan room. If one assumes that the increase in radiation levels at the fan room door since the last filter change, about 18 mr per hour at a point about ten feet from the primary filter, represents material deposited on the new filter, the primary filter inventory is about 0.2 Curies. Radiation measurements at contact on the primary and secondary filters are about 2 R/hr and 0.2 R/hr respectively, but the secondary filter is only about one meter from the primary filter. This means that virtually all of the radiation measured at the secondary filter could be from material on or near the primary filter. Therefore, the inventory on the secondary filter is no more than, and certainly much less than, 0.02 Curies.

The most plausible mechanism for release of a part of the inventory would be mechanical damage or fire damage. Neither is likely because the filters are isolated in a separate room. But the consequence of the hypothetical release of a substantial part of the inventory held in the filters can be readily estimated. In a real accident involving the filters, it is likely that only a small fraction of the inventory would be released. Furthermore, it is likely that a release would occur during average atmospheric dispersion conditions. For purposes of a bounding analysis, however, it is assumed that the entire estimated filter inventory of 0.2 Curies is released. It is further assumed that release occurs in poor dispersion conditions, stable atmospheric conditions and a wind speed of 2 meters per second. Given these conditions, and given initial dilution in the wake of the building, the risk-weighted committed inhalation lung dose (ICRP 30) at the receptor point, would be 42 millirem. Inhalation doses to other organs would be lower. For comparison, the annual dose limit in the proposed revision to 10 CFR Part 20 is 100 millirem for a member of the public. Radiation levels one meter above a smooth, flat plane at the receptor location would be about 0.2 mR/hour, low enough to preclude the need for immediate emergency response. The details of these calculations are shown in Table 1.

Results from the effluent air sampling program will give information useful in determining the effectiveness of the treatment system as a whole. A technique for periodic determination of filter inventory by radiation survey of the filters may be workable and useful in providing sensitive indication of the performance of the primary filter and the isotope inventories of both filters. This will be examined in the future.

TABLE 1

CALCULATION OF DOSE FROM RELEASE OF COBALT-60

1.0 INPUT VARIABLES

Pasquill stability class	F
Q, quantity assumed to be released, Ci	0.2
x, downwind distance to receptor, meters	100
vdep, deposition velocity, meters per second (Ref. 1)	0.01
u, wind speed, meters/sec	2
sigz, vertical dispersion parameter, meters (Ref. 2, p. 103)	2.4
sigy, horizontal dispersion parameter, meters (Ref. 2, p. 104)	4
A, cross-sectional area of building, square meters	200
c, area constant, (Ref. 3, p. 302)	0.5
IDF, ICRP 30 risk-weighted inhalation dose factor for lung, mrem per pCi (Ref. 4)	1.5E-04
GDF, ground dose factor, mrem/hr per pCi/square meter (Ref. 5, Table E-6)	1.7E-08
BR, breathing rate, cubic meters per year (Ref. 5, Table E-5)	8000

2.0 CALCULATED VARIABLES

X/Q, dispersion parameter value, sec/cubic meters

DIN, 50-year committed inhalation dose, millirem

DGR, penetrating radiation dose rate one meter above material deposited on smooth plane, millirem/hour

3.0 Calculation of X/Q

From Ref. 3, equation 7.30:

X/Q = MAXIMUM OF 1/((pi*sigz*sigy+c*A)*u) OR 1/(3*pi*sigz*sigy*u)

X/Q = 5.5E-03 sec/cubic meter

TABLE 1 (CONT'D)

CALCULATION OF DOSE FROM RELEASE OF COBALT-60

4.0 Calculation of DIN

DIN = Q * X/Q * BR * IDF * 3.17E-08 * 1.0E12

yr/sec pCi/Ci

DIN = 42 millirem

5.0 Calculation of DGR

DGR = Q * X/Q * vdep * GDF * 1.0E12

pCi/Ci

DGR = 0.19 millirem/hour

REFERENCES

1. NCRP, Radiological Assessment: Predicting the Transport, Bioaccumulation, and Uptake by Man of Radionuclides Released to the Environment, NCRP 76, 1984.

2. Slade, D. (ed.), Meteorology and Atomic Energy, TID-24190, 1968.

3. Randerson, D. (ed.), Atmospheric Science and Power Production, DOE/TIC-27601, 1984.

4. ICRP, Limits for Intakes of Radionuclides by Workers, ICRP Publication 30, Supplement to Part 1, 1978.

5. USNRC, Regulatory Guide 1.109, Rev. 1

MEMORANDUM

DATE: May 16, 1989

TO: J. W. Corun
W. J. Costley
T. E. Potter
J. A. Ransohoff

FROM: F. Schwoerer

SUBJ: HOT CELL EXHAUST SYSTEM - MEASURED FLOWRATE

This is a report of measurements made on May 3, 1989 of the air flow velocity distribution in the discharge duct of the Hot Cell Exhaust System.

The measurement location was outside the wall between the fan room and the roof of the hot cell, as shown in Attachment #1.

The equipment used consisted of:

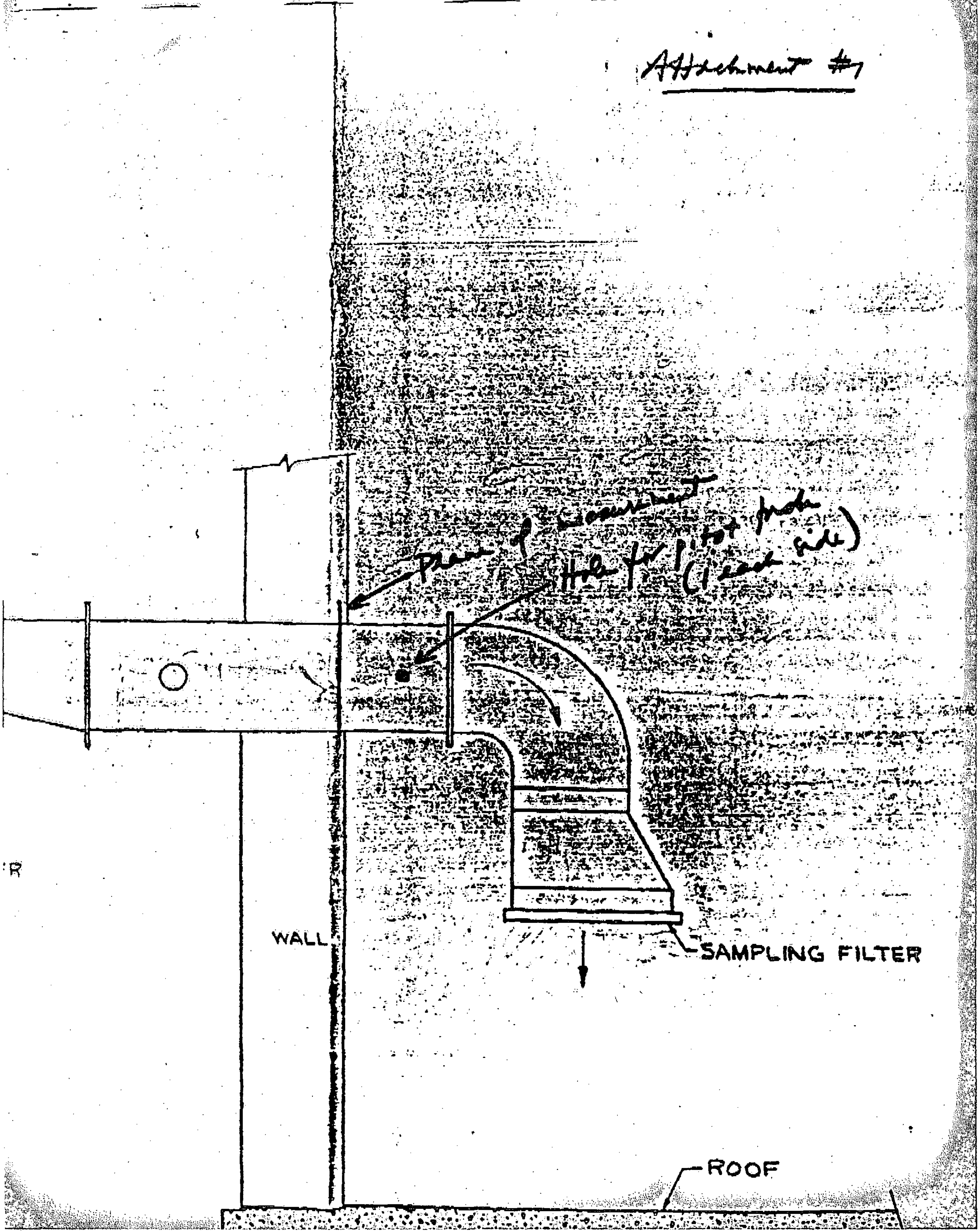
- A Dwyer dual-range dial manometer, which reads directly 500-2800 ft per minute air velocity,
- A Dwyer pitot probe (160-18), of 18" length and 5/16" diameter,
- Portable accessory kit, and
- Simple protractor and simple 12" scale.

The air velocity was measured at 25 points in the plane measurement. The locations of the 25 points are shown in Attachment #2. For each point, the necessary depth and angle of probe insertion, to place the active end of the probe at the point location, were precalculated. Holes were drilled into each side of the duct, as shown in Attachment #1. The probe was then positioned, using the protractor and scale, supplemented by a scale marked on the probe, to conform to the positions shown in Attachment #2.

Air velocities, which were relatively stable with time, were read directly off the manometer and tabulated in Attachment #3.

The velocity data were then plotted and averaged, as shown in Attachment #4.

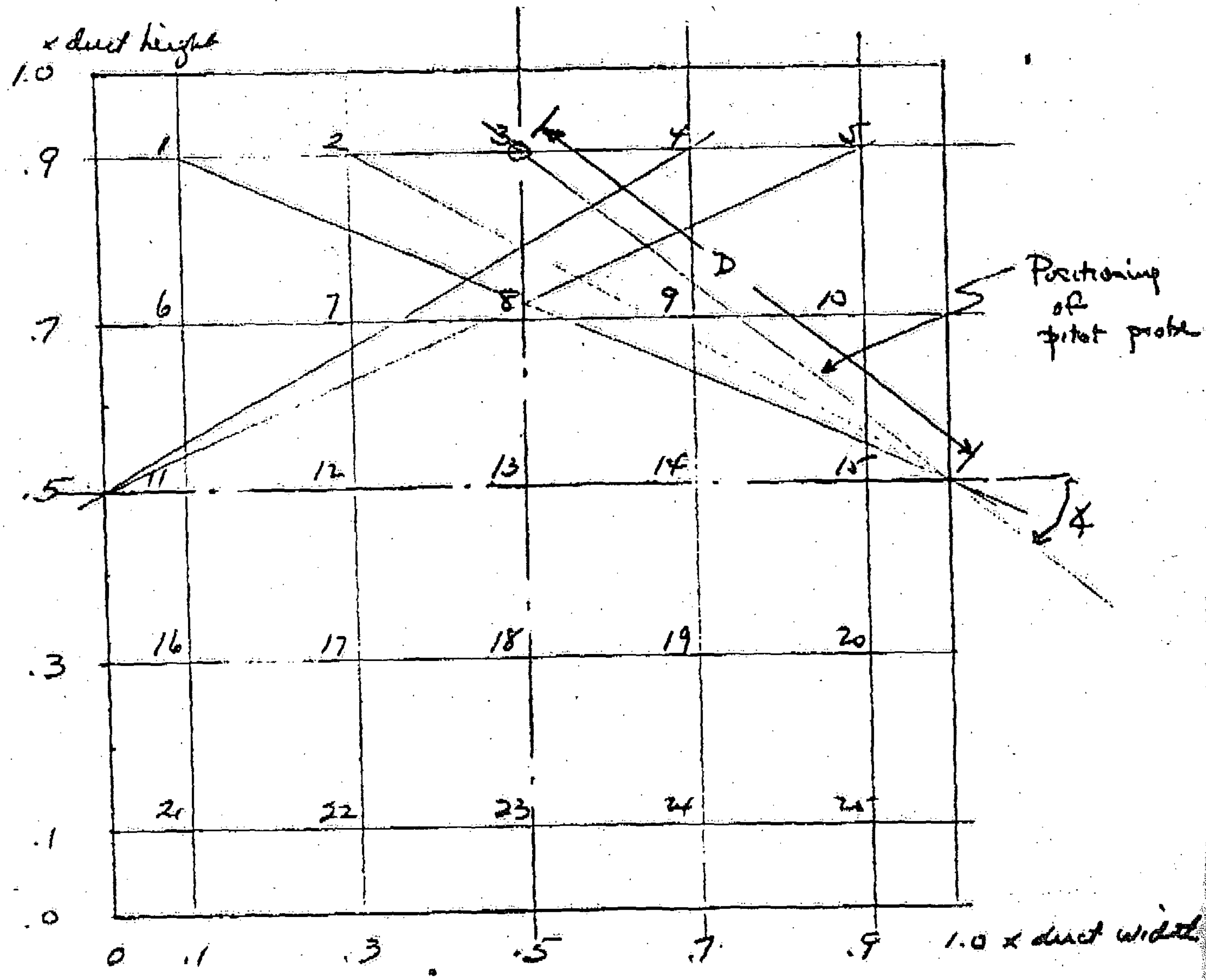
Attachment #1



Attachment #2

Measurement Points in Plane of Measurement

Duct dimensions: 11" x 11"

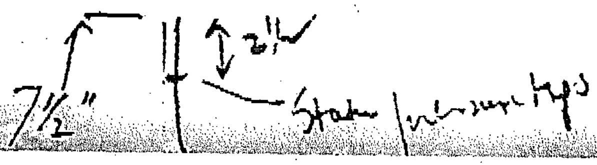


Looking towards blower

i.e., flow direction is out of the paper

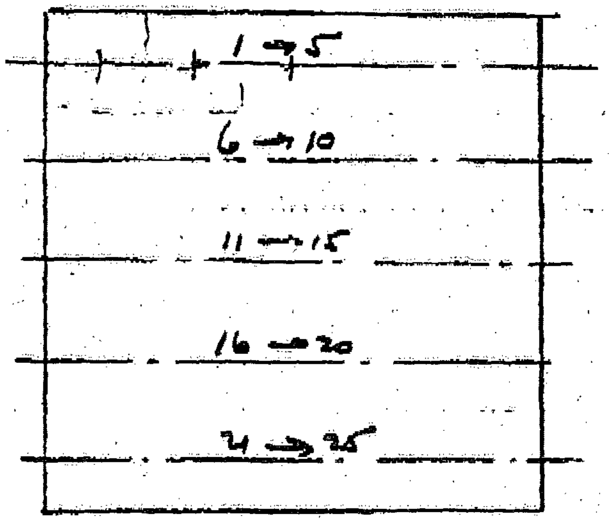
Attachment #3

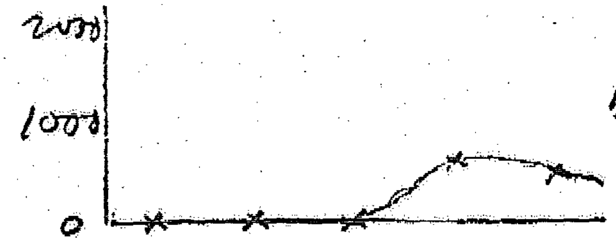
Pt #	Y	11×11 D	V	Vol
3	51	7.04	1'0 fpm	
8	22	5.93	400	
13	0	5.5	1100	
18	−22	5.93	1500	
23	−51	7.04	1300	
2	30	8.87	0	
7	16	8.0	0	
12	0	7.7	800	
17	−16	8.0	1100	
22	−30	8.87	1300	
1	24	10.8	0	
6	12.5	10.1	0	
11	0	9.9	600	
16	−12.5	10.1	1400	
21	−24	10.8	1000	
4	30	−8.9	600	
9	16	−8	800	
14	0	−7.7	1300	
19	−16	−8	1700	
24	−30	−8.9	1800	
5	24	−10.8	500	
10	12.5	−10.1	800	
15	0	−9.9	1600	
20	−12.5	−10.1	1900	
25	−24	−10.8	1800	



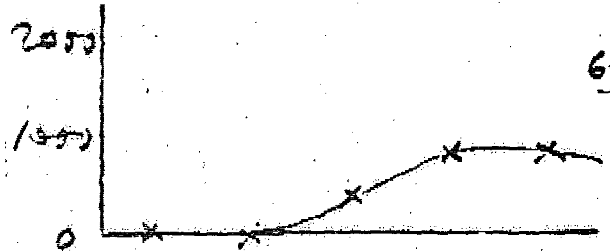
Attachment #4

Flow direction - out of paper

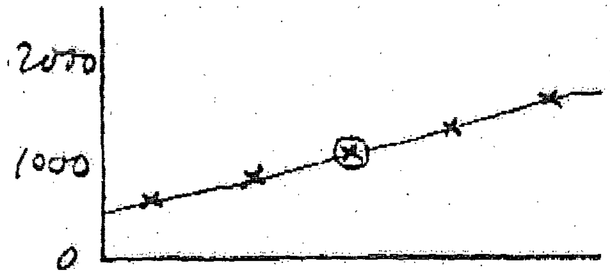




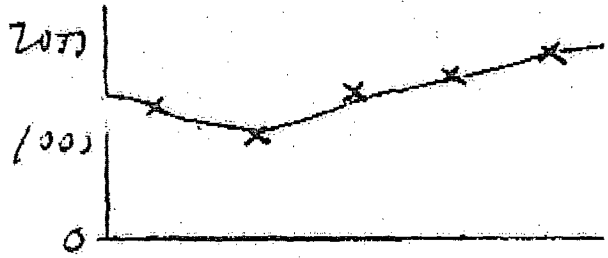
1→5
AVG = 220



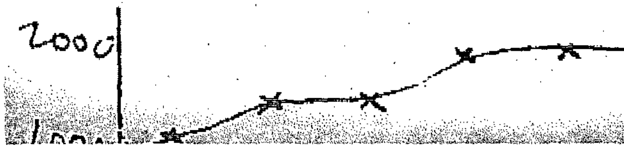
6→10
AVG : 400



11→15
AVG = 1080



16 → 20
AVG = 1520



21 → 25
AVG = 1440

overall avg
= 932 fpm

Area = $(\frac{11}{12})^2$ = .84 ft^2

∴ flow ≈ 800 cfm.