IN-DEPTH SURVEY REPORT:
EVALUATION OF GENERAL EXHAUST VENTILATION SYSTEM

at

Internal Revenue Service
Service Center
Fresno, California

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SITE SURVEYED:	IRS Service Center, Fresno, California
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Mention of company names or products does not constitute endorsement by the Centers for Disease Control and Prevention.

EXECUTIVE SUMMARY

As a result of an evaluation by National Institute for Occupational Safety and Health (NIOSH) researchers of the general exhaust ventilation system for negative-pressure rooms at the Internal Revenue Service (IRS) Service Center in Fresno, CA, the following recommendations are made:

Recommendations for Non-Working Hours
Using the information in Table 4, the IRS should be able to determine how long to run existing HVAC systems during off-hours to both mitigate the effects of a possible contaminant release and save money on energy costs. For instance to decrease contaminant by about 99%:

- The system should run for approximately 1.3 hours in the Extracting Room.
- The system should run for approximately 52 hours in SCAMPS I.
- The system should run for approximately 19.6 hours in SCAMPS II.

Local Exhaust Ventilation
In order to maximize the effectiveness of ventilation systems to protect workers from acts of bioterrorism, the IRS should consider using local exhaust ventilation (LEV) as part of an overall ventilation system in the SCAMPS areas. The benefits of such a system would be that:

- The air currents at the point of contamination would draw contaminant away from SCAMPS room workers, providing them with much more protection than is currently employed.
- By capturing the contaminant close to the source, much lower air flows are needed to cover the area of contamination. This would result in lower costs for air handling and treatment of make-up air.
- The general air flows in the rooms would be more protective of workers by moving "clean" air, from areas of the room where contaminant is not likely to be released, past workers and to the LEV.

Maintaining Negative Pressure
Tracer gas experiments showed that tracer gas escapes from SCAMPS II to "positive-pressure" areas of the building when the doors are opening and closing. In order to better meet minimum requirements, the IRS should consider installing an exhaust system into SCAMPS II in order to keep this room under negative pressure when doors are opening and closing.

Supply Air into the SCAMPS Rooms
Neither SCAMPS I nor SCAMPS II currently employs fresh supply air as part of its ventilation system. Introducing fresh supply air would accomplish several objectives:

- Any contaminant released in these rooms would be diluted more quickly, better protecting the health of SCAMPS room inhabitants in the case of a bioterrorist attack.
- By bringing in fresh supply air, the variable flow drives (VFD) in SCAMPS II would engage more frequently because of the resultant pressure differential (currently set for .01 "wg). This would result in faster contaminant decay and would allow IRS facilities personnel to turn off HVAC systems in these rooms during off hours sooner.
- Introducing fresh air into these rooms would help the IRS meet Indoor Air Quality guidelines.

Other Recommendations
The following are other recommendations made based on the results of the survey that the IRS should consider:

- The filtration component of the Computer Room Air Conditioning (CRAC) units in SCAMPS I should not be considered adequate to filter biologically contaminated air.
- In order to save money, the IRS might consider re-entraining exhaust air from the Extracting Room and SCAMPS rooms back into the facility after passing through a high efficiency particulate air (HEPA) filtration system.
- If, however, IRS facilities personnel determine that exhaust air should not be re-entrained into the facility but rather exhausted to the atmosphere, the air can either be unfiltered or pass through a lower efficiency air filter like a MERV-14 or MERV-16.

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) is located in the Centers for Disease Control and Prevention (CDC), within the Department of Health and Human Services. NIOSH was established in 1970 by the Occupational Safety and Health Act at the same time that the Occupational Safety and Health Administration (OSHA) was established in the Department of Labor (DOL). The OSHAct legislation mandated NIOSH to conduct research and education programs separate from the standard-setting and enforcement functions conducted by OSHA. An important area of NIOSH research deals with methods for controlling occupational exposure to potential chemical and physical hazards.

The Engineering and Physical Hazards Branch (EPHB) of the Division of Applied Research and Technology (DART) has been given the lead within NIOSH to study and develop engineering controls and assess their impact on reducing occupational illness. Since 1976, EPHB (and its forerunner, the Engineering Control and Technology Branch) has conducted a large number of studies to evaluate engineering control technology based upon industry, process, or control technique. The objective of each of these studies has been to evaluate and document control techniques and to determine the effectiveness of the control techniques in reducing potential health hazards in an industry or for a specific process.

At the request of the Internal Revenue Service (IRS), researchers from NIOSH evaluated the ventilation system at the IRS service center in Fresno, California. The Fresno IRS field study which took place on July 22, 23, and 24, 2004, was conducted to: characterize the ventilation system; measure contaminant decay rates in the various negative pressure rooms; and provide cost effective recommendations to better protect workers from acts of bioterrorism and to enhance the air quality of the rooms.

BACKGROUND

The Service Center Automated Mail Processing System (SCAMPS) Rooms and Extracting Rooms in IRS facilities work on a negative pressure system. The change in pressure restricts the air flow in the facility, forcing air to flow from positive pressure areas to negative pressure areas where contaminants from bioterrorist attacks are more likely to be released. Although the negative/positive pressure system is an effective way to confine possible airborne contaminants and other potential risks to the SCAMPS and Extracting Rooms, the system is also costly. NIOSH was asked to evaluate the system's ability to protect workers from contaminants and to make recommendations on possible ways to reduce costs.

The current ventilation system in the Fresno service center varies from room to room. The following are brief descriptions of the present ventilation systems in the Extracting and SCAMPS Rooms:

- The SCAMPS II room has no supply or exhaust vents. The air flow in this room is generated by an internal air circulation unit. The presence of fresh supply air in this room is limited and air exhausted into the adjoining SCAMPS I room is minimal.

- Scamps I also does not have supply vents. This room only receives air when the east door (connected to the positive pressure loading dock area) opens and closes, and

from minor cracks and crevices in the room's wall structure. Air exhausts from the room when one (or both) of two variable-frequency drives (VFDs) are activated. For relative locations and volumetric flow rates of VFDs see Figures 1 and 2.

- The Extracting Room has both supply and exhaust systems; both of which are constantly operating. This room is equipped with 6 constant-flow drives which continually exhaust air at a constant rate, and 2 VFDs that are activated by a pressure differential between the Extracting Room and positive-pressure areas. For relative locations and volumetric flow rates of constant-flow drives and VFDs see Figures 1 and 2.

METHODS

Mass Air Flow Measurements

Volumetric flow rates and *air velocity measurements* were made for all exhaust and supply systems in the Extracting Room and SCAMPS I. The volumetric flow rates were measured by the Accubalance Plus Air Capture Hoods (TSI Incorporated, St. Paul, MN). As a source of comparison and confirmation, air velocities were measured at the center of each ventilation grill using the Velocicalc® Plus anemometer (TSI Incorporated, St. Paul, MN); also dimensions of the ventilation grill duct were recorded.

Manometer Measurements

Air pressure measurements were recorded in the Extracting and SCAMPS Rooms using the Velocicalc® Plus manometer (TSI Incorporated, St. Paul, MN). The pressure reading in the room of interest was used as the calibration factor. Readings were made during experimentation with doors closed from the room of interest to outside doors. Specific locations can are shown in Table 4.

Room Volumes

Volumes for the Extracting and SCAMPS Rooms were initially approximated using AutoCAD floor plans of the Fresno facility. Room dimensions were subsequently taken on-site using a PLS laser measure (Pacific Laser Systems, Sausalito, CA); volumes were recalculated using these measurements.

Smoke Release Observations

Smoke tubes (MSA Company, Pittsburg, PA) were used to release smoke in order to observe air flow patterns at doors of areas of interest. If the smoke remained in the room it was released in, this was a good indication the air was confined to that particular room. These observations were made for doors that connect the negative pressure rooms to the positive pressure rooms.

Tracer Gas Experimentation

NIOSH researchers have used sulfur hexafluoride (SF_6) as a tracer gas for years to analyze indoor air systems. The gas is non-toxic at appropriate levels (Threshold Limit Value of 1000 parts per million(ppm)) and is colorless and odorless. At the Fresno Service Center, tracer gas was released into the rooms for an initial concentration of approximately 4 ppm for each experiment – the upper limit of detection for the SF_6 monitors. Release of tracer gas was intended to simulate an actual situation in which contaminant was introduced into negative-pressure rooms. To this end, SF_6 was directly fed into the ventilation system through: the supply vent in the Extracting Room; the two crack units in the SCAMPS I room; and the internal air circulation unit in the SCAMPS II room. In each experiment, the release of tracer gas was controlled by a Variable Area Flowmeter (Advanced Specialty Gas Equipment® , Middlesex, NJ).

Six MIRAN® 203 Specific Vapor Analyzers (The Foxboro Company, Foxboro, MA), were placed in various locations inside and outside of the three negative-pressure rooms to monitor the tracer gas concentration levels in ppm (see Figure 3 for MIRAN locations in each room). The MIRANs were set to zero preceding the initial experiment for each room. Voltage Data Loggers (MicroDAQ® , East Warner, NH) recorded the output signal from

each MIRAN in 15 second intervals. As an additional source of data, visual recordings of MIRAN readings were periodically taken.

Various scenarios were tested with tracer gas experimentation. For instance, in SCAMPS II, conditions corresponding to: 1) non-working hours; 2) normal operation with SCAMPS I in use; and 3) operations when SCAMPS I was shut down were simulated. Also, conditions simulating 1) non-working hours and 2) normal working conditions were used for experimentation in SCAMPS I and the Extracting Room. See Table 1 for full details of experimentation conditions.

RESULTS AND DISCUSSION

Manometer Measurements
Manometer readings are summarized in Table 2. Results are presented in "inches of water column" – a unit measuring pressure. One inch of water column equals a pressure of 0.03613 pounds per square inch (PSI). One notable observation is that at the time of experimentation, SCAMPS I experienced equal pressure relative to SCAMPS II and the Extraction Room.

Room Volumes
Room volumes were calculated as follows: 1140 cubic meters in the SCAMPS II Room; 3214 cubic meters in the SCAMPS I Room; and 7079 cubic meters in the Extracting Room; these volumes are also summarized as a part of Table 1.

Smoke Release Observations
Smoke release observation results are summarized in Table 3. These observations suggest the following:

- SCAMPS II pressure is slightly negative relative to SCAMPS I since smoke was slightly drawn into SCAMPS I.
- SCAMPS II pressure is negative relative to the rest of the building when the doors are closed which was confirmed by smoke being drawn quickly into SCAMPS II when released near the door.
- SCAMPS I pressure is negative relative to the rest of the building when the doors are closed which was confirmed by smoke being drawn quickly into SCAMPS II when released near the door.
- Extracting Room pressure is negative relative to the rest of the building and SCAMPS II when the doors are closed which was confirmed by smoke being drawn quickly into SCAMPS II when released near the door. This remained true even when the doors were opened.

Tracer Gas Experimentation
Graphs for tracer gas experiments are shown in Figures 4-10 in which a) the voltage corresponding to tracer gas levels is plotted against b) time (voltages were not converted into their corresponding tracer gas levels since the conversion factors cancel out during calculations). The results are summarized in Figure 11 and Table 4. Using Table 4, the IRS can determine how long it would approximately take to reach desired contaminant concentrations. For instance, consultation of Table 4 indicates that with all doors closed, 99% contamination decay would require approximately 1.3 hours in the Extracting Room,

19.6 hours in SCAMPS II and 52 hours in SCAMPS I. Similar results are reported for other scenarios and for other decay concentrations.

It should be noted that although tracer gas did not escape from the SCAMPS I Room and Extracting Room to positive-pressure areas of the building, instrumentation **did** detect tracer gas leakage from the SCAMPS II room to the maintenance area of the building during experiments when the doors to this area were opening and closing (see Location F in Figure 10).

CONCLUSIONS AND RECOMMENDATIONS

Recommendations for Non-Working Hours

Using the information in Table 4, the IRS should be able to determine how long to run existing HVAC systems during off-hours to both mitigate the effects of a possible contaminant release and save money on energy costs. For instance:

- In the Extracting Room, the IRS may consider turning off HVAC systems after approximately 1.3 hours during periods when no one inhabits the room. Any potential contaminant generated during working hours would most likely be decreased by about 99% during this time period.
- Similarly, the IRS might consider turning off HVAC systems after approximately 52 hours during periods when no one inhabits the SCAMPS I Room to attain about 99% contaminant decay. This time period is expectedly extensive since the SCAMPS I Room is relatively large, very well sealed, and doesn't experience fresh-supply air; as a matter of practice, the 52 hour waiting period will most likely be longer than a typical weekend.
- For the SCAMPS II Room, the IRS might consider turning off HVAC systems after approximately 19.6 hours during non-working to attain about 99% contaminant decay

Local Exhaust Ventilation

In order to maximize the effectiveness of ventilation systems to protect workers from acts of bioterrorism, the IRS should consider using local exhaust ventilation (LEV) as part of an overall ventilation system in the SCAMPS areas. The LEV system would capture contaminants close to the point of potential release and exhaust to either 1) the outside or 2) through a high efficiency filtration system for re-entrainment into the building. Please see Figure 12 for a rough schematic of where an LEV enclosure or hood might be placed on IRS mail-processing equipment. The benefits of such a system would be that:

- The air currents at the point of contamination would draw contaminants away from SCAMPS room workers, providing them with much more protection than is currently employed.
- By capturing the contaminant close to the source, much lower air flows are needed to remove the contamination. This would result in lower energy costs for air handling and treatment of make-up air.
- The general air flows in the rooms would be more protective of workers by moving "clean" air, from areas of the room where contaminant is not likely to be released, past the worker and to the LEV. Currently, it is possible for contaminated air to be trapped in areas not under the influence of short-circuited air currents or in eddies.

Maintaining Negative Pressure

The IRS has determined that, at a minimum, the SCAMPS rooms and Extracting Room should be kept under negative pressure relative to the rest of the building in order to mitigate the effects of a possible bioterrorist attack. However, tracer gas experiments showed that tracer gas escapes from SCAMPS II to "positive-pressure" areas of the building when the doors are opening and closing. In order to better meet minimum requirements, the IRS should consider installing an exhaust system into SCAMPS II in order to keep this room under negative pressure when doors are opening and closing.

Additionally, IRS facilities personnel should take measures to maintain a pressure differential of -.01 to -.04 "wg between negative and positive pressure rooms as recommended in the Industrial Ventilation Manual[1] and in CDC literature[2].

Supply Air into the SCAMPS Rooms

Neither SCAMPS I nor SCAMPS II currently employs fresh supply air as part of its ventilation system. Rather, air infiltrates into the room via cracks and crevices between the SCAMPS rooms and other areas. Introducing fresh supply air would accomplish several objectives:

- Any contaminant released in these rooms would be diluted more quickly, better protecting the health of SCAMPS room inhabitants in the case of a bioterrorist attack.
- By bringing in fresh supply air, the variable flow drives (VFD) in SCAMPS II would engage more frequently because of the resultant pressure differential. This would result in faster contaminant decay and would allow IRS facilities personnel to turn off HVAC systems in these rooms during off hours sooner.
- Introducing fresh air into these rooms would help the IRS meet Indoor Air Quality guidelines like ANSI/ASHRAE 62-1999 or those in the Industrial Ventilation Manual. For instance, ANSI/ASHRAE 62-1999 recommends that 20 cubic feet per minute of outside air be introduced per person in an office environment,[3] whereas currently these rooms experience minimal air exchange due to the fact that no fresh air is supplied and the rooms are so well sealed.

Other Recommendations

The following are other recommendations made based on the results of the survey that the IRS should condisder:

- The filtration component of the Computer Room Air Conditioning (CRAC) units in SCAMPS I should not be considered adequate to filter air for biological contamination. These units' exhausts and supplies are so close (about 6 feet

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[1] (American Conference of Governmental Industrial Hygienists. Industrial Ventilation Manual, 24th ed. Cincinnati, OH: ACGIH, 2001, pg 7-4.)

[2] Centers for Disease Control and Prevention. HICPAC Guideline for Environmental Infection Control in Health-Care Facilities, 2003: MMWR June 6, 2003 / 52(RR10);1-42

[3] American Society of Heating, Refrigerating and Air-Conditioning Engineers. "ASHRAE Standard 62-1999, Ventilation for Acceptable Indoor Air Quality."

- apart) that short circuiting of the air currents is likely – keeping aerosolized contaminant from becoming entrained into the CRAC units' filtration.
- In order to save money, the IRS might consider re-entraining exhaust air from the Extracting Room and SCAMPS rooms back into the facility after passing through a high efficiency particulate air (HEPA) filtration system.
- If, however, IRS facilities personnel determine that exhaust air should not be re-entrained into the facility but rather exhausted to the atmosphere, the air can either be unfiltered or pass through a lower efficiency air filter like a MERV-14 or MERV-16.

Table 1. Testing Schedule and Conditions for Tracer Gas Testing .

Room	Time Start	Time Stop	Conditions	Notes/Purpose
SCAMPS II (Vol. = 1140 m^3)	7:41 AM	8:25 AM	no doors open	to simulate weekend / non-working conditions
	8:25 AM	8:47 AM	north door to building opening every minute	to simulate SCAMPS II operating when SCAMPS I is contaminated
	8:49 AM	9:09 AM	• south door to SCAMPS II opening every 2 minutes • east SCAMPS II door to building opening every 2 minutes	to simulate full-capacity, when both SCAMPS rooms are being used
Extracting (Vol. = 7079 m^3)	11:59 AM	12:59 PM	no doors open	to simulate weekend / non-working conditions
	2:03 PM	2:34 PM	• east SCAMPS II door to building opening every 30 seconds • north door to SCAMPS I room opening every 5 minutes	to simulate normal operations
SCAMPS I (Vol. = 3214 m^3)	3:25 PM	4:35 PM	no doors open	to simulate weekend / non-working conditions
	4:35 PM	5:05 PM	• north door to SCAMPS II opening every 5 minutes • south door to Extracting opening every minute • east door to building opening every 30 seconds	to simulate normal operations

Table 2: Manometer Readings

Extracting Room relative to Main Building (taken near sliding door)	**-.05 "wg**
Extracting Room relative to Main Building (taken near NW swing door)	**-.06 "wg**
Extracting Room relative to Main Building (taken near S swing door)	**-.03 to -.04 "wg**
SCAMPS I relative to Main Building (taken near sliding door)	**-.01 to -.03 "wg**
SCAMPS I relative to SCAMPS II (taken near sliding door)	**.00 "wg**
SCAMPS I relative to Extracting Room (taken near sliding door)	**.00 "wg**
SCAMPS II relative to Main Building (taken near sliding door)	**-.03 "wg**
SCAMPS II relative to Main Building (taken near sliding door)	**-.02 to -.03 "wg**

Table 3. Smoke Release Observations.

SCAMPS II - near SCAMPS I door	Smoke was slightly drawn into SCAMPS II. Didn't go into SCAMPS I
SCAMPS II - near small exhaust vent (by door to SCAMPS I)	Smoke quickly drawn into vent
SCAMPS II - near large recirculating exhaust vent (across from door to SCAMPS I)	Smoke quickly drawn into vent
SCAMPS II - near large sliding door to building	Smoke stayed in room. Didn't go to main building
SCAMPS II - near large recirculating exhaust vent (across from sliding door to building)	Smoke quickly drawn into vent
SCAMPS I – near sliding door to SCAMPS II	Smoke generally stayed stationary. Didn't go into SCAMPS II
SCAMPS I – near CRAC unit (zone 118 / near sliding door between SCAMPS I and II)	Smoke quickly drawn into unit
SCAMPS I – near CRAC unit (zone 125 / near sliding door to building)	Smoke quickly drawn into unit
SCAMPS I – near CRAC unit (zone 124)	Smoke quickly drawn into unit
SCAMPS I – near CRAC unit (zone 119 / near sliding door between SCAMPS I and Extracting)	Smoke quickly drawn into unit
SCAMPS I – near sliding door to building	Smoke drawn away from door into room
Extracting Room - outside sliding door to SCAMPS I	With door closed, smoke stayed in room and was drawn upwards With door open, smoke went slightly into Extracting Room
Extracting Room - inside sliding door to SCAMPS I	Smoke stayed in the Extracting Room
Extracting Room - outside sliding door to main building	Smoke quickly drawn into Extracting Room
Extracting Room - inside sliding door to main building	Smoke quickly drawn into Extracting Room
Extracting Room - near door (D45)	Smoke drawn into Extracting Room
Extracting Room - near door # 1-2 (Emergency door)	Smoke slightly drawn into room. Didn't go out the door
Extracting Room - near door by fire sprinkler	Smoke stayed in Extracting Room

Table 4. Decay Rates Detected by SF_6 Testing for Various Scenarios in the Extracting Room and SCAMPS Rooms.

	AVG time to decay 99% (hours)	Min time to decay 99% (hours)	Max time to decay 99% (hours)
EXTRACTING ROOM -DOORS CLOSED	1.1	0.8	1.3
EXTRACTING ROOM -DOORS OPENING	2.1	1.5	3.1
SCAMPS II AREA-DOORS CLOSED	16.6	13.2	19.6
SCAMPS II AREA- ONE DOOR OPENING	9.3	7.2	11.0
SCAMPS II AREA- 2 DOORS OPENING	13.4	13.0	13.9
SCAMPS I AREA-DOORS CLOSED	36.6	28.9	52.0
SCAMPS I AREA-DOORS OPENING	12.0	10.9	13.8
	AVG time to decay 95%	Min time to decay 95%	Max time to decay 95%
EXTRACTING ROOM -DOORS CLOSED	0.7	0.5	0.9
EXTRACTING ROOM -DOORS OPENING	1.3	1.0	2.0
SCAMPS II AREA-DOORS CLOSED	10.8	8.6	12.8
SCAMPS II AREA- ONE DOOR OPENING	6.1	4.7	7.2
SCAMPS II AREA- 2 DOORS OPENING	8.7	8.4	9.0
SCAMPS I AREA-DOORS CLOSED	23.8	18.8	33.8
SCAMPS I AREA-DOORS OPENING	7.8	7.1	9.0
	AVG time to decay 90%	Min time to decay 90%	Max time to decay 90%
EXTRACTING ROOM -DOORS CLOSED	0.6	0.4	0.7
EXTRACTING ROOM -DOORS OPENING	1.0	0.8	1.6
SCAMPS II AREA-DOORS CLOSED	8.3	6.6	9.8
SCAMPS II AREA- ONE DOOR OPENING	4.7	3.6	5.5
SCAMPS II AREA- 2 DOORS OPENING	6.7	6.5	6.9
SCAMPS I AREA-DOORS CLOSED	18.3	14.4	26.0
SCAMPS I AREA-DOORS OPENING	6.0	5.5	6.9

Figure 1. Relative Locations on Roof of IRS Fresno, CA Service Center for: Extracting Room Constant Flow Drives and Variable Frequency Drives; and Scamps I Variable Frequency Drives

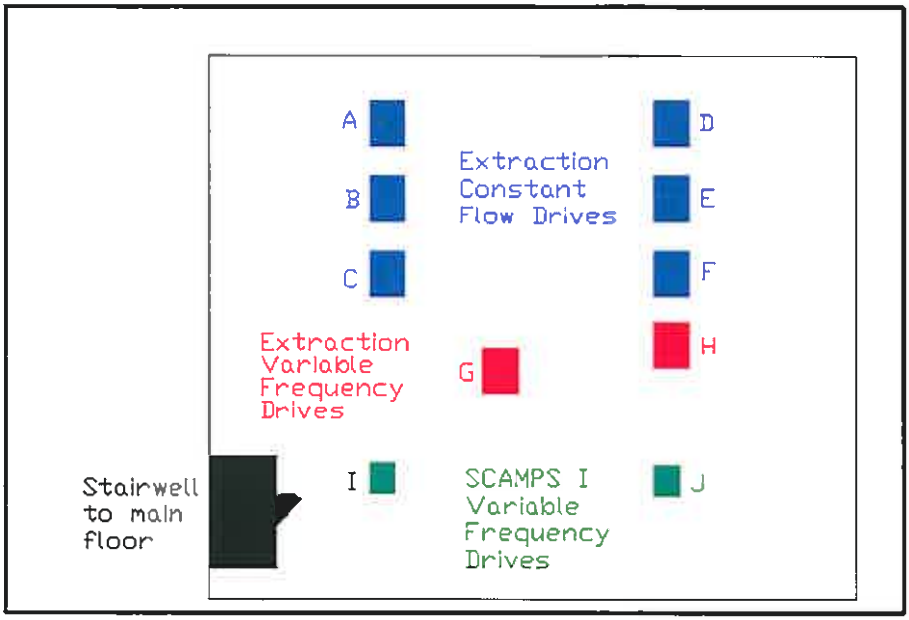

Figure 2. Flow Rates of Constant Flow Drives and Variable Frequency Drives in Extracting and SCAMPS I Rooms (location letters correspond to Figure 1)

Location	Total flow (cfm)
A	5607
B	5517
C	5864
D	5328
E	5499
F	5391
G	215
H	300
I	65
J	744

Figure 3. Overview of Extracting Room and SCAMPS Rooms and Locations of Miran 203 Tracer Gas Monitors (blue rectangles represent MIRAN locations)

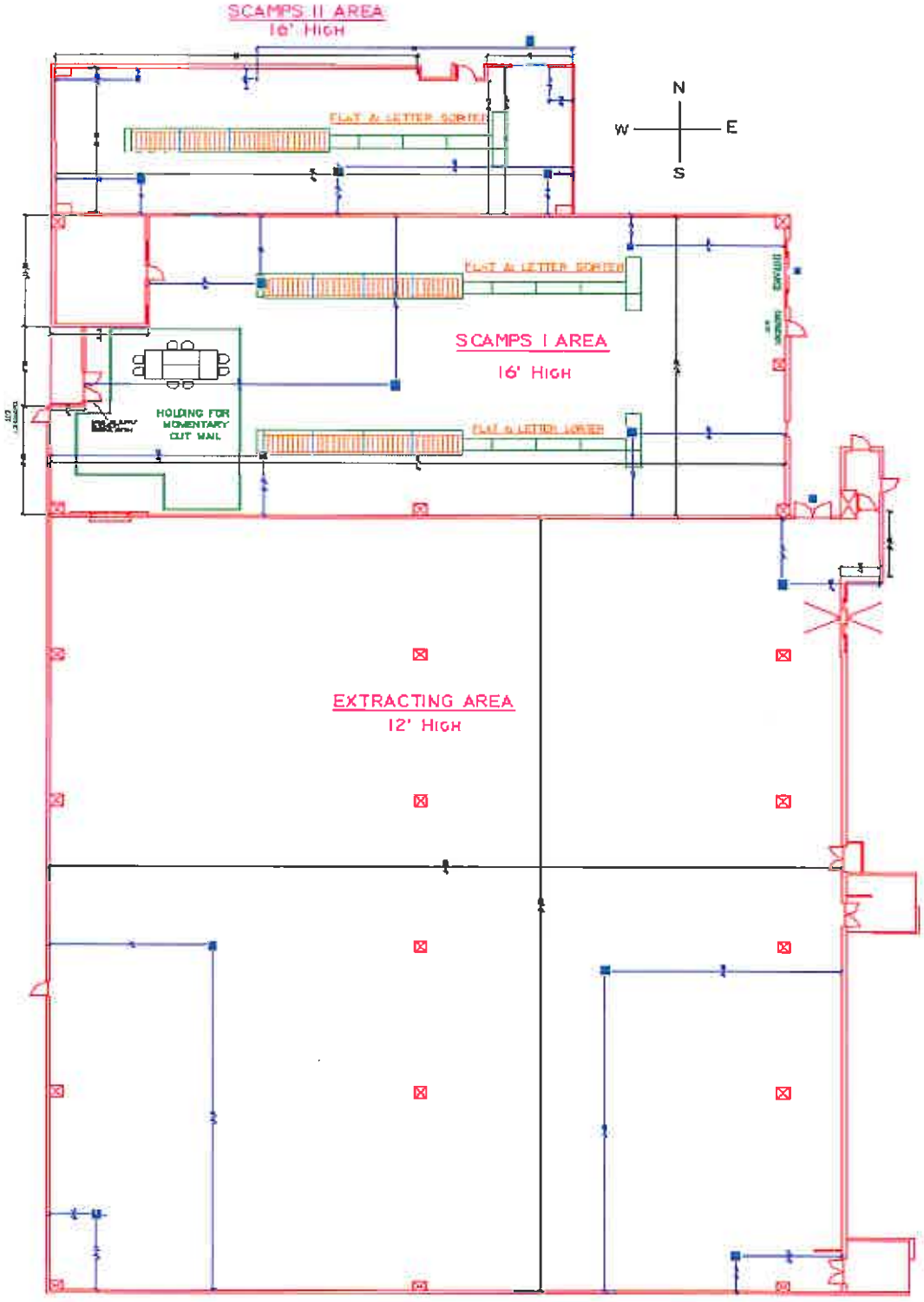

Figure 4. Decay Curves for Experiment #1: Inside SCAMPS II with the Doors Closed to Simulate Non-Working Hours

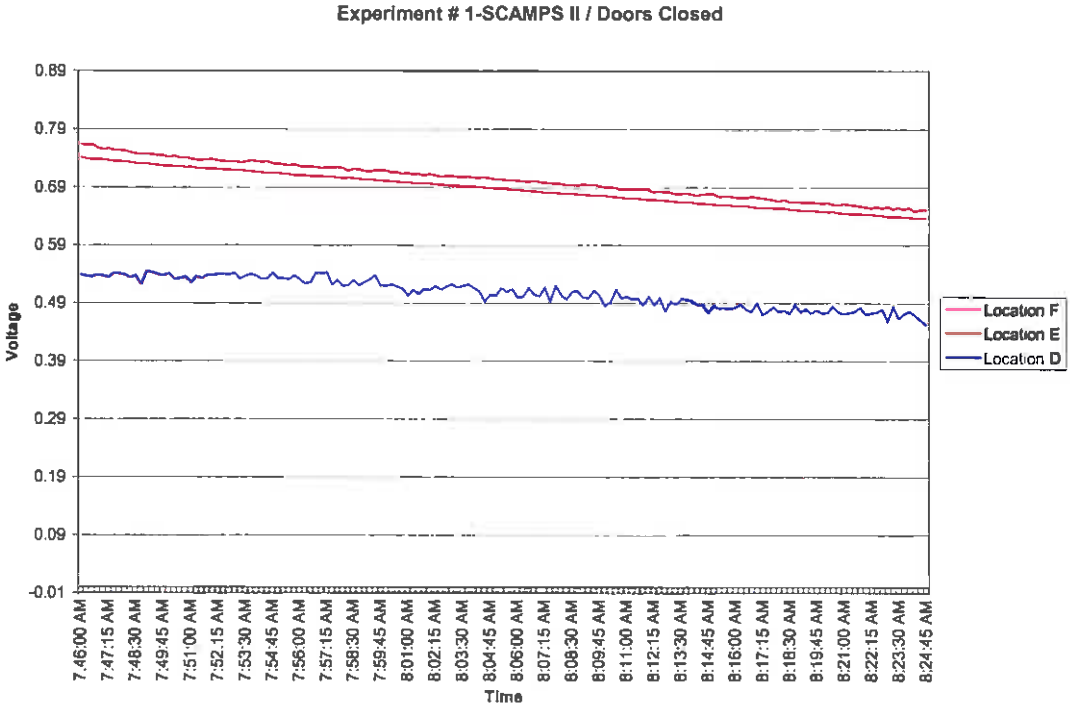

Figure 5. Decay Curves for Experiment #2: Inside SCAMPS II with the North Door Opening and Closing Every Minute to Simulate SCAMPS II Working When SCAMPS I is Contaminated

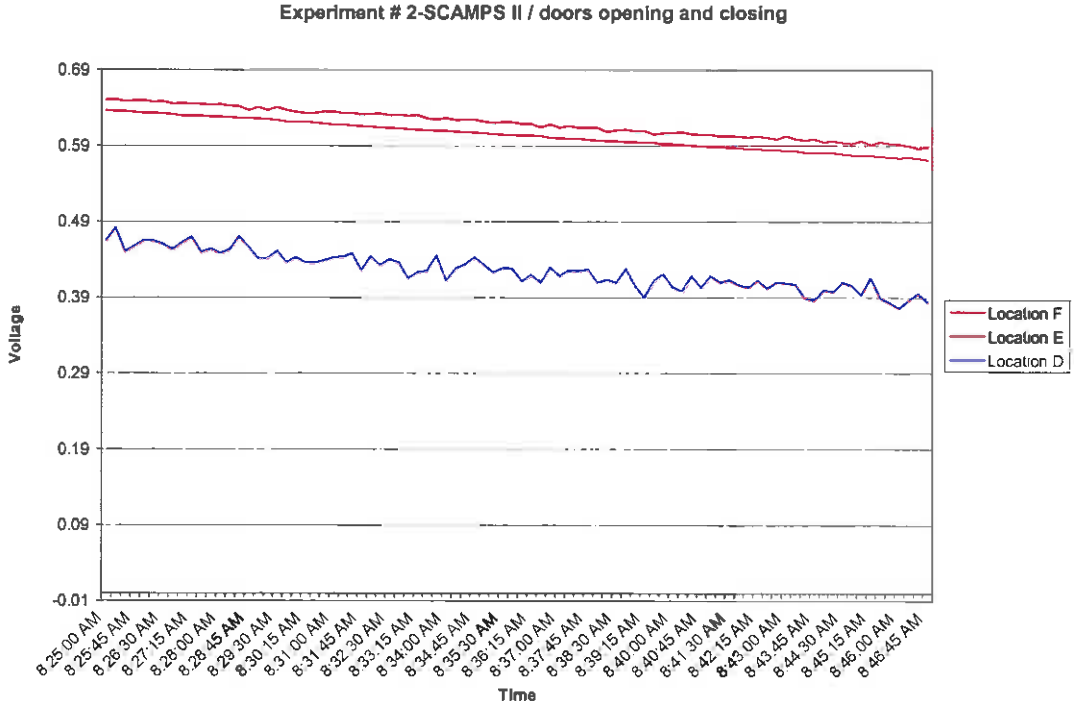

Figure 6. Decay Curves for Experiment #3: Inside SCAMPS II with the Doors Opening and Closing Every 2 Minutes to Simulate Working at Full-Capacity in Both SCAMPS Rooms

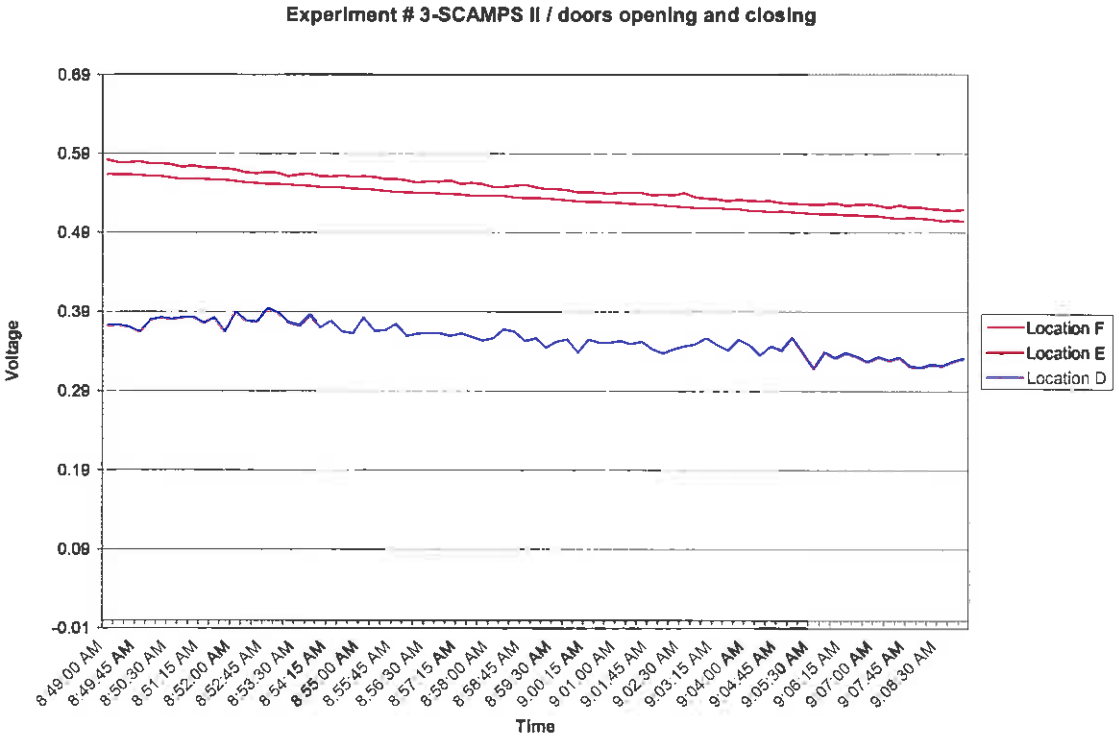

Figure 7. Decay Curves for Experiment #4: Inside Extracting Room with the Doors Closed to Simulate Non-Working Hours

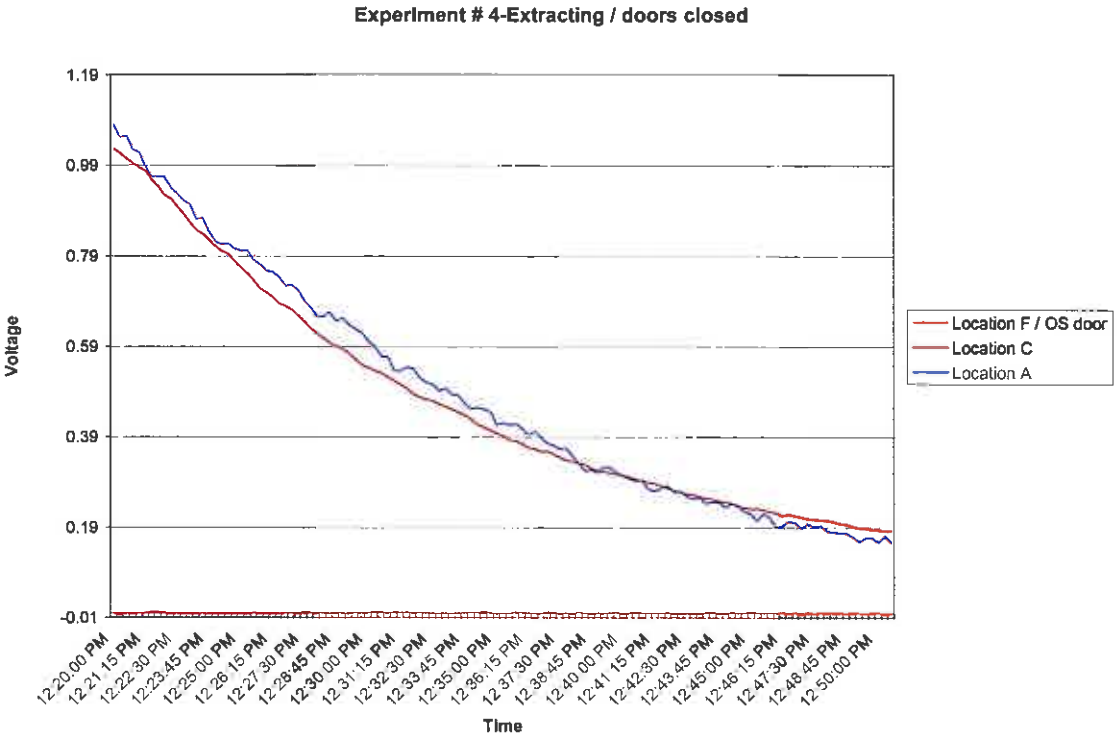

Figure 8. Decay Curves for Experiment #5: Inside Extracting Room with the Doors Opening and Closing to Simulate Normal Working Operations

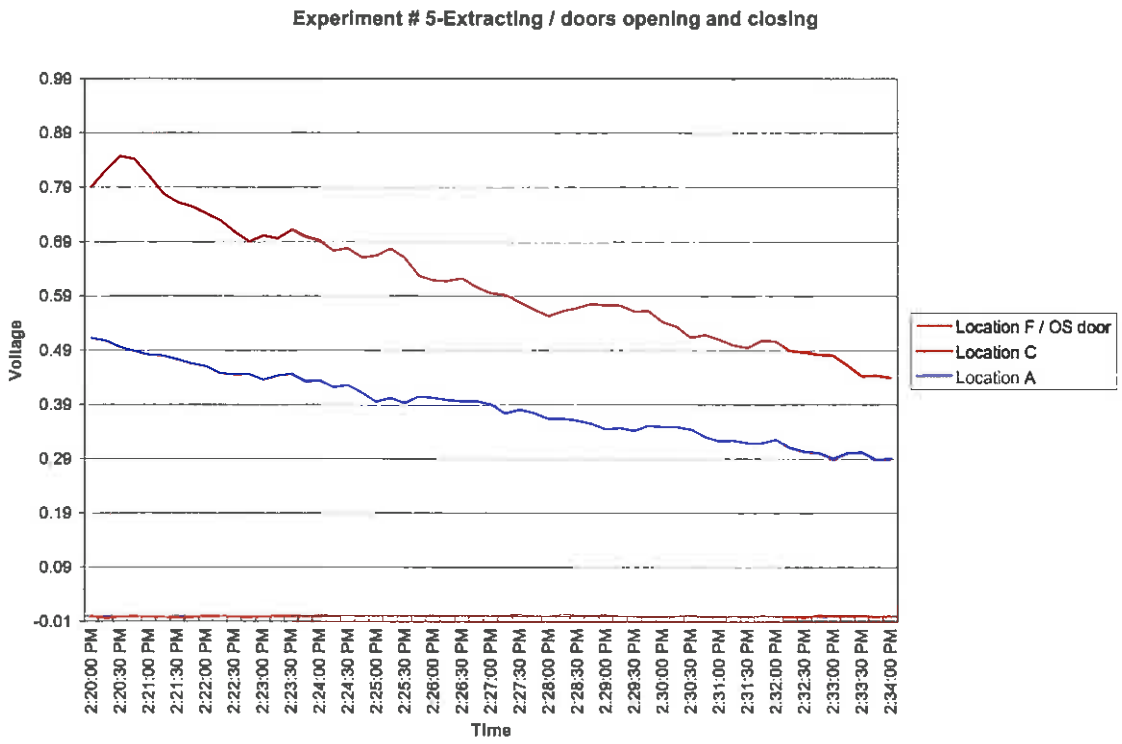

Figure 9. Decay Curves for Experiment #6: Inside SCAMPS I with the Doors Closed to Simulate Doors Closed to Simulate Non-Working Hours

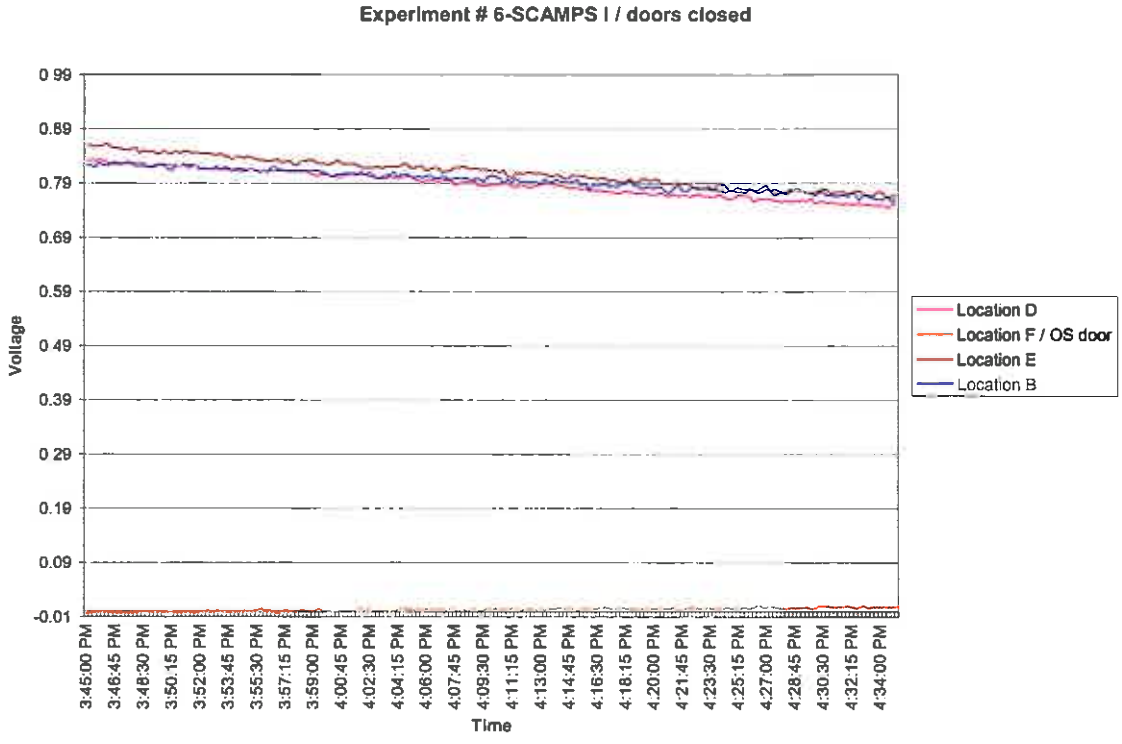

Figure 10. Decay Curves for Experiment #7: Inside SCAMPS I with the Doors Opening and Closing to Simulate Doors Closed to Normal Operations

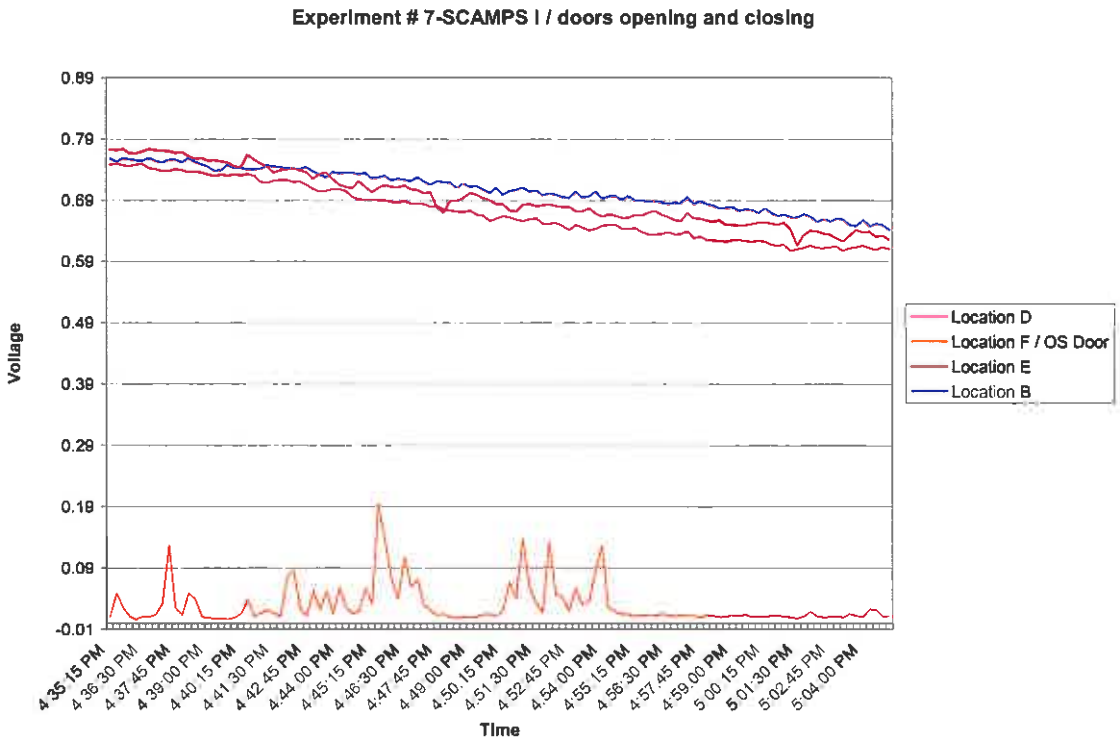

Figure 11. Average Time for Contaminant Decay by 90%, 95% and 99% for Various Scenarios.

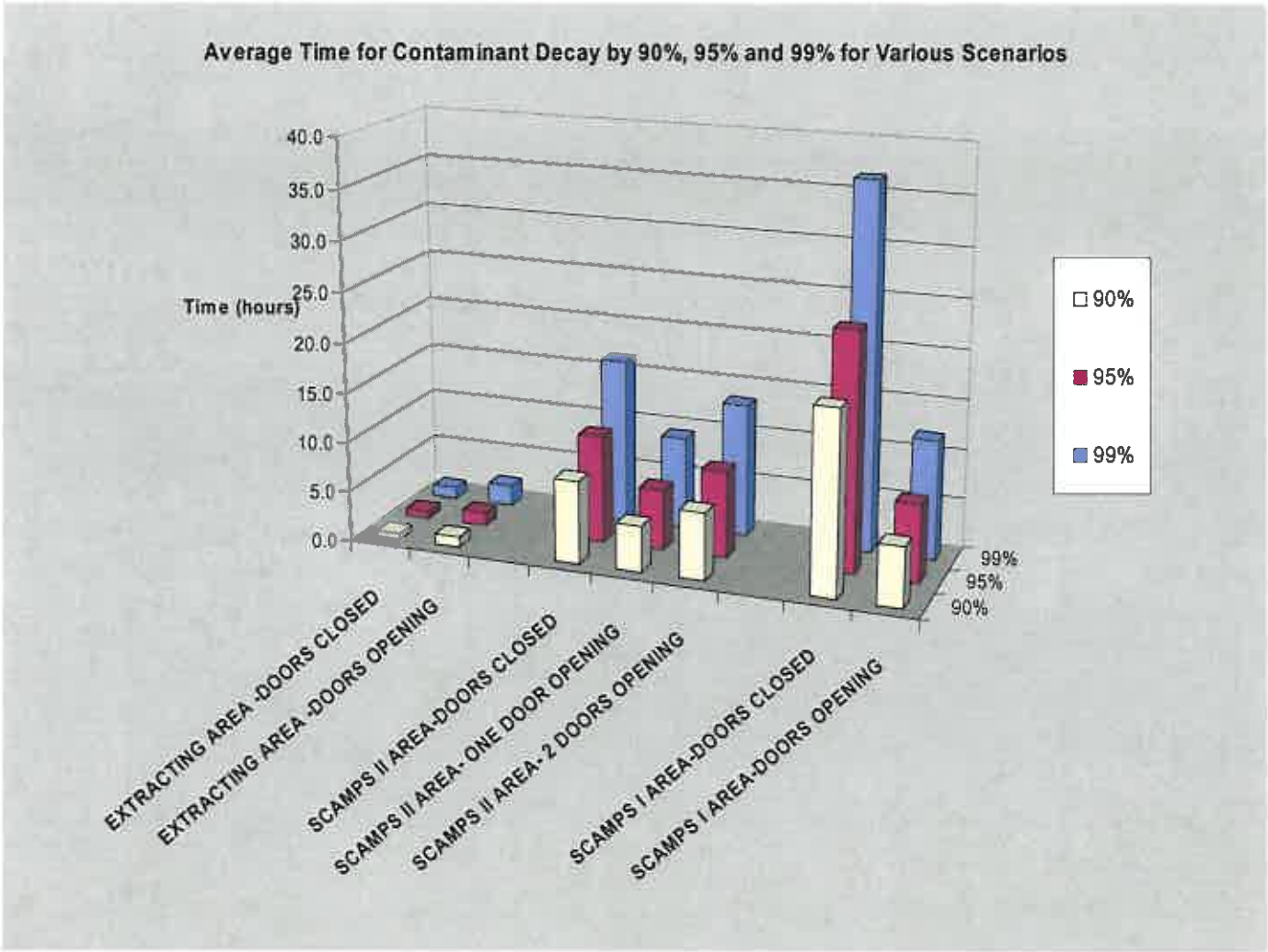

Figure 12. Schematic of Possible Location for LEV on SCAMPS Rooms Mail-Processing Machinery (the red strip signifies where LEV ductwork could be used to help entrain air away from the worker's breathing zone)

Figure 13. Example Location of Miran in the Extracting Room.