DOE/HWP-166

HAZWRAP

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM

Leading the Way to Environmental Stewardship

U.S. POSTAL SERVICE RADON ASSESSMENT AND MITIGATION PROGRAM PROGRESS REPORT FOR THE PERIOD SEPTEMBER 1993 TO NOVEMBER 1994

December 31, 1994

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U.S. Department of Energy
Oak Ridge Operations Office

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
Environmental Restoration and Waste Management Programs
Oak Ridge, Tennessee 37831-7606
managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

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ACRONYMS AND INITIALISMS

ACH	air changes per hour
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
BD	blower door
DMS	data tracking and management system
CRM	continuous radon monitoring
DOE	Department of Energy
DP	differential pressure
EPA	Environmental Protection Agency
FH	flow hood
FVF	Flow per Volume Factor
GSA	General Services Administration
HAC	heating and air conditioning
HAZWRAP	Hazardous Waste Remedial Actions Program
HPLF	high pressure/low flow
HRV	heat recovery ventilation
HVAC	heating, ventilation, and air conditioning
IAG	Interagency Agreement
IRAA	Indoor Radon Abatement Act
LPHF	low pressure/high flow
ORNL	Oak Ridge National Laboratory
pCi/L	picocurie per liter
PFET	pressure field extension test
POC	point of contact
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
REP	radon entry pathway
SMD	submembrane depressurization
SP	shell pressurization
SS	subslab
SSD	subslab depressurization
USEPARTCs	U.S. Environmental Protection Agency Response Training Centers
USPS	U.S. Postal Service

EXECUTIVE SUMMARY

In 1992, the U.S. Postal Service (USPS) entered into an Interagency Agreement (No. 2055-E065-A1) with the Department of Energy (DOE) whereby DOE would provide technical assistance in support of the USPS Radon Assessment and Mitigation Program. To aid in this effort, DOE tasked the Hazardous Waste Remedial Actions Program (HAZWRAP), which is managed by Martin Marietta Energy Systems, Inc., for DOE under contract DE-AC05-84OR21400. Since that time, HAZWRAP has developed and finalized the sampling protocol, mitigation diagnostic protocol, and the quality assurance and quality control procedures. These procedures were validated during the Protocol Validation (1992–1993) and Pilot Study (1993–1994) phases of the program. To date, HAZWRAP has performed approximately 16,000 radon measurements in 250 USPS buildings. Mitigation diagnostics have been performed in 27 buildings. Thus far, 13% of the measurements have been above the Environmental Protection Agency action level of 4 pCi/L. This report summarizes the pilot program radon testing data and mitigation diagnostic data for 22 sites and contains recommendations for mitigation diagnostics.

1. INTRODUCTION

1.1 BACKGROUND OF THE U.S. POSTAL SERVICE RADON TESTING PROGRAM

In 1988 as a result of the Indoor Radon Abatement Act (IRAA), the General Services Administration (GSA) began conducting radon testing of all leased space under its control. Included in this study was space leased from the U.S. Postal Service (USPS). In 1991, GSA provided to USPS Headquarters several lists identifying 77 USPS buildings where a single reading greater than the Environmental Protection Agency (EPA)-recommended 4-pCi/L action guideline was measured. Concerned about possible radon exposure to USPS employees in the 36,000 USPS buildings nationwide, the USPS National Environmental Office reviewed existing EPA radon testing methodologies and procedures and found that EPA had not published any guidelines for large-building testing. To date, EPA has still not released a final protocol for the testing of radon in nonresidential buildings. The reason for the delay is that the development of a single testing protocol to cover all types of nonresidential buildings has proven to be extremely difficult. The tentative release date for the large-building testing protocol is still pending.

Aware of the Department of Energy (DOE) role in the U.S. Navy Radon Assessment and Mitigation Program, USPS contacted DOE in 1991 to inquire about potential assistance with a national USPS radon testing program. In 1992, DOE entered into an Interagency Agreement (IAG) (DOE No. 2055-E065-A1) with USPS whereby DOE would provide technical support to USPS on a task-order basis. As detailed in the IAG, this technical support would consist of radon surveys, assessments, cost-benefit analyses, mitigation design/specifications, data management and validation, training development, and technical writing. To aid in the fulfillment of its responsibilities to USPS, DOE selected the Hazardous Waste Remedial Actions Program (HAZWRAP), which is managed by Martin Marietta Energy Systems, Inc., for DOE under contract DE-AC05-84OR21400.

In April 1992, the USPS National Environmental Office requested assistance from HAZWRAP in the development of a prototypical USPS-specific radon testing and mitigation diagnostics protocol. The protocol emphasis was data interpretation and understanding of all aspects of the radon cycle: testing, diagnostics, mitigation, and postmitigation for USPS buildings. USPS requested that the protocol address the following topics in-depth: interpretation and limitation of radon test results, public relations aspects of a radon problem, mitigation diagnostics and data interpretation, mitigation consideration and design, postmitigation testing, maintenance of a mitigation system, and data and information management. For technical support in the development of the USPS protocol, HAZWRAP contacted the research staff at Oak Ridge National Laboratory (ORNL).

In May 1992, after a review of USPS needs and requirements, HAZWRAP provided to USPS a project outline for conducting a national radon testing program in USPS buildings. Briefly, the outline is as follows:

1. Conduct long-term radon testing of all ground-contact rooms in all USPS buildings over a 2- to 5-year period (Phase 1);

2. In buildings that have radon in excess of 4 pCi/L, perform mitigation diagnostics tests to identify the best method(s) for radon control (Phase 2);

3. Based on the data collected in Phase 2, install a radon mitigation system (Phase 3); and

4. After system installation, perform postmitigation radon testing and develop a building-specific management plan for maintaining radon control (Phase 4).

An evaluation of the proposed testing methods and procedures was performed at 38 USPS sites during 1992 and 1993 and reported in *Radon Levels and Diagnostics at 38 U.S. Postal Service Sites* (DOE/HWP-140), dated August 16, 1993. Based on the initial success of the development program, USPS requested that HAZWRAP conduct a pilot study using more sensitive electret devices.

1.2 OVERVIEW OF RADON

Radon is a naturally occurring, odorless, colorless, radioactive gas results from the decay of uranium in soil. For many years, radon was not considered to be a health problem in residential buildings. But in 1984, private homes in the Reading Prong area of Pennsylvania were discovered to have levels of radon in excess of federally mandated exposure limits for radiation workers. Radon is not considered to be a human carcinogen; however, the short-lived, alpha-emitting progeny has been demonstrated to induce lung cancer. Excessive exposure to radon progeny is known to have resulted in more than the predicted number of deaths from lung cancer in mining populations (Bier et al. 1988). Nero (1986) estimated that about one million American homes have radon levels in excess of 8 pCi/L (1 pCi/L = 37 Bq/m^{-3}). Based on this and other information, EPA estimated that between 5,000 to 20,000 lung cancer deaths per year are attributed to radon exposure (*A Citizen's Guide To Radon*, OPA-86-004).

Radon migrates from surrounding soil into buildings through cracks in concrete slabs, basement cinder blocks, and air spaces around pipes. Radon can also collect in crawl spaces and then flow into living and work areas. The flow of radon into the living area of a building is caused by both natural diffusion and pressure-assisted flow. Natural diffusion usually contributes only a small amount of radon within a building. In most cases, elevated radon can be attributed to a process known as pressure-driven flow. This process can be both natural or man-made. Natural pressure-driven flow (or thermal stack effect) is due to the rising and exiting of warm air within a building. As warm air rises, "makeup" air is pulled into the building through slab and wall imperfections. If the imperfections are in contact with soil, the building radon concentration increases. Man-made means of enhancing radon entry are primarily caused by slight negative pressure caused by the operation of a furnace, ventilation fan, or clothes dryer. Certain weather conditions, such as wind and rain, can also induce transient increases in the building radon level.

In recognition of the public health hazard presented by indoor radon, the U.S. Congress passed and the President signed into law the IRAA. IRAA declares the national goal to be "that the air within buildings in the United States should be as free of radon as the ambient air outside the buildings." In addition, the law stipulates that the head of each federal agency that manages a building will design a study to assess the extent of radon contamination in buildings within that agency's jurisdiction.

1.3 U.S. POSTAL SERVICE PILOT RADON TESTING AND MITIGATION PROGRAM

The primary goal of the USPS pilot program was to evaluate the USPS radon testing protocol over a wider cross section of buildings in different regions. In addition, further development of a data tracking and management system (DMS) capable of performing the entire program was to be performed. For this study, approximately 12,000 measurements were to be made and reported. The duration of the tests were to be between 90 and 120 days each and be conducted during two climatic phases.

1.3.1 U.S. Postal Service Site Prioritization

Nationwide, USPS manages up to 36,000 buildings ranging in size from less than 200 to more than 1,000,000 ft^2. Using the existing protocol, between 300,000 to 400,000 radon measurements would be needed for both owned and leased USPS buildings. As currently planned, the testing of all USPS buildings would be completed within the next 5 years. Because some USPS sites could be more susceptible to elevated radon than others, USPS tasked HAZWRAP to develop a ranking system for site prioritization. To perform this task, HAZWRAP collected radon testing data from EPA and other federal and state agencies. Each state was assigned a radon availability score based on the projected percentage of buildings with radon in excess of 4 pCi/L. Using the building-size information provided by USPS, an estimate was made on the number of employees present at the site, and an employee score was assigned. A product of the two scores (radon availability score × employee score) for each of the 36,000 sites was then calculated. To compensate for local (e.g., Guam, Reading Prong Area, and Clinton, New Jersey) historical data that indicated extremely high radon levels, a localized factor was added to certain product scores. All of the sites' product scores were then ranked sequentially with testing priority given to the sites with the highest overall scores.

1.3.2 Site Selection

At the request of USPS, the pilot study only involved USPS-owned buildings. From the ranking score (Sect. 1.3.1), a list of the top 200 USPS-owned sites was generated. These sites were then grouped into specific target regions (e.g., Chicago, Minneapolis, Memphis). Smaller USPS-owned sites within a 30-mile radius of the main region site were then included in the target region list. All sites within the region were classified as primary (must be tested), secondary (alternate site), and tertiary (no testing at this time). Each of the target regions was then classified as a predominant heating and/or cooling region. The estimated number of detectors for all sites within a target region was then calculated. These sample density estimates were based on historical data collected during the 1992–1993 protocol evaluation study. Telephone contact was then established with the Postmaster of each of the primary sites in the target region, and a date was established for the ORNL project team to place the detectors. If the Postmaster at the primary site declined to participate in the study, an alternative region was selected. For a given region, a fixed number of detectors was assigned for deployment and a final list of regional sites was generated. Table 1 summarizes the primary target regions tested.

In addition to the primary sites (Table 1), single USPS sites requiring <200 detectors were selected for shipment of detectors to be placed by USPS personnel. The purpose of this study was to determine the responsiveness of USPS personnel in deploying the detectors and to evaluate the usefulness of the *U.S. Postal Service Radon Testing Guidebook*, which is an instructional handbook on how to place and retrieve radon detectors.

Table 1. Regional U.S. Postal Service sites selected for radon testing

Regional site	Season
Chicago, Illinois	Heating
Minneapolis, Minnesota	Heating
St. Paul, Minnesota	Heating
Cincinnati, Ohio	Heating and cooling
Dayton, Ohio	Heating and cooling
Memphis, Tennessee	Heating and cooling
Nashville, Tennessee	Heating and cooling
Chattanooga, Tennessee	Heating and cooling
Lehigh Valley, Pennsylvania	Heating
Knoxville, Tennessee	Heating and cooling
Denver, Colorado	Heating and cooling
Reading, Pennsylvania	Heating
Atlanta, Georgia	Cooling
Stanford, Connecticut	Heating
Dallas, Texas	Cooling
Central Oklahoma (Tulsa, Norman)	Cooling

1.3.3 Sample Plan

To ensure that no area of a USPS building contained elevated radon, each ground-contact room was tested for radon. Ground-contact areas tested included all stairwells, pipe chases, elevator shafts, and other interzonal conduits. In addition to testing ground-contact areas, main postal workrooms not in ground contact were sampled at an interval of one detector for every 5000 ft^2. To better understand radon transport within multistory USPS sites, certain sites (selected at random by the field teams) had upper-floor sampling performed.

1.4 DETECTOR SELECTION FOR THE PILOT PROGRAM

In 1992, USPS selected reusable, electret-based radon testing devices to monitor radon levels within USPS buildings. Electret-based radon detectors consist of two distinct parts, the ion chamber and the electret. The ion chamber is a specially designed holder for the electret, which is made of electrically conducting plastic. This feature allows for the uniform discharge of static energy generated by the decay of radon or radon daughters in the air inside the chamber.

Electrets consist of an electrically charged wafer of Teflon® that has been treated to hold a stable electrostatic potential. This potential attracts oppositely charged ions, which collect on the electret surface, neutralizing the surface charge and reducing the electrostatic potential. The surface potential is measured before and after exposure using a specially designed voltage reader. The decrease in surface potential during exposure is proportional to the concentration of radon integrated over time. When new, the voltage of an electret is between 700 to 750 V, and the electret can be reused until the voltage drops below 200.

The discharge rate, or volts per unit time per radon concentration, depends on the volume of the ion chamber and on the sensitivity of the electret. High-sensitivity electrets discharge at a rate 11 times that of low-sensitivity electrets. For short duration tests, such as 90-day tests, a higher discharge rate is needed for better accuracy. For example, a 90-day measurement conducted at 1 pCi/L of radon with a low-sensitivity electret would yield only a 6-V drop, while a high-sensitivity electret would yield 66 V. The higher voltage drop results in an increase in accuracy of about 50% in this example. Conversely, for longer exposures, such as 240 days, the drop in voltage for the high-sensitivity electret would be 176 V, or 35% of the usable voltage for the electret. The low-sensitivity electret would drop only 16 V, losing only 3% of its usable voltage.

1.4.1 Lessons Learned from the Evaluation Study

During the 1992–1993 USPS protocol evaluation study, USPS selected the model L-LT E-Perm manufactured by Radelec® (Fig. 1). Overall, the performance of the detector was good. However, the following problems were identified during the study that could have potentially complicated a nationwide radon survey.

- **Special packaging and handling**

  The design of the model L-LT radon detector is such that it cannot be turned off. Therefore, each detector required special packaging in airtight Mylar® bags with radon-absorbing material. Also, once retrieved, the detector would have to be repackaged in Mylar® bags by USPS site personnel before returning the detectors for analysis.

- **Short shelf life**

  Although the detector is enclosed within an airtight Mylar® bag, background gamma radiation will result in voltage discharge. Studies conducted at ORNL determined that the detectors had an approximate 30-day shelf life for a 1-year exposure period. Once exceeded, the detectors would have to be returned, reread, and repackaged before use. This limitation would require prompt deployment by USPS personnel at the sites. Conversely, once the detector had been retrieved, it must be returned and read within 14 days.

- **Long exposure period**

  For best results, Radelec® recommends that the model L-LT detector be deployed for a minimum of 120 days. However, significantly higher precision and accuracy are attained at testing periods approaching 1 year. The chief advantage of electret-based radon detectors is the ability to reuse them and lower the overall testing cost. A cost-benefit analysis performed

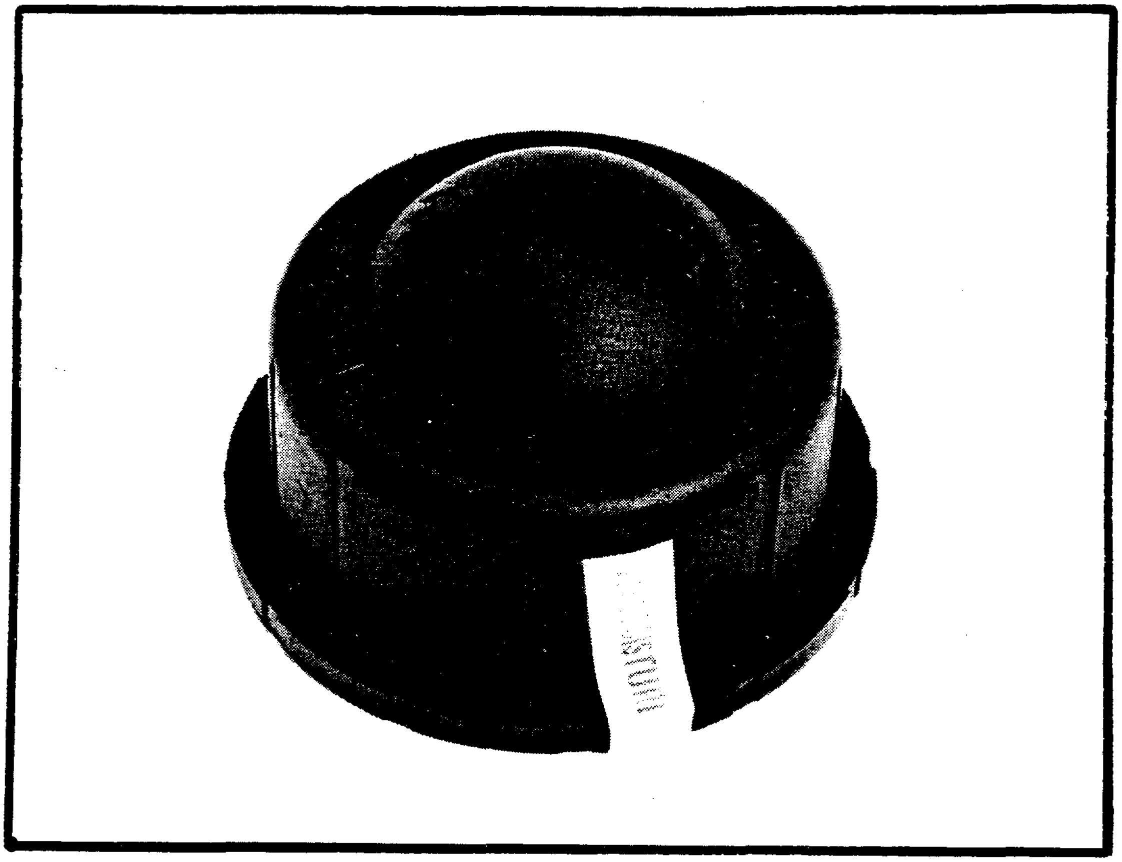


Fig. 1. The model L-LT E-Perm detector was used during the 1992–1993 U.S. Postal Service protocol evaluation study.

by HAZWRAP estimated that a 90- to 120-day exposure period offered the best performance per unit exposure cost. The analysis showed that a longer exposure period would increase the number of detectors needed for a full testing program geometrically. If the model L-LT were used for the full program, approximately 2.2 times as many detectors would be needed for a 1-year sample period vs a 90- to 120-day period.

1.4.2 Electret Chamber Selection

Based on the findings of the evaluation program, USPS requested that HAZWRAP evaluate the model S ion chamber (Fig. 2) for suitability during the pilot program. The advantages of using the S ion chamber are as follows:

- **No special packaging**

  By design, the model S ion chamber can be activated or deactivated by opening or closing the cap. This eliminates the need for Mylar® packaging for both placement and retrieval.

- **Longer shelf life**

  The model S ion chamber has a longer shelf life when compared to the L chamber because it can be deactivated when not in use. Studies conducted by ORNL found that the detectors have a 60-day storage life (longer duration studies are ongoing). The extended storage life would provide additional time for field deployment.

- **Shorter testing period**

  For best results, Radelec® recommends that the model S-LT detector be deployed for a minimum of 90 days. However, higher precision and accuracy are attained at testing periods approaching 120 days. Therefore, in theory, the S-LT detector falls within the optimal cost-benefit range.

1.4.3 Gamma Detectors

Although marketed as a radon gas detector, the E-Perm monitor is fundamentally a detector of ion-pairs generated inside the ion chamber by radiation sources. External gamma rays originating from natural external sources (e.g., building materials, soil) can and do cause a voltage decrease. If this is not corrected, the result could be a sizable increase in reported radon concentration. Thus, Radelec® publishes a gamma correction table that lists the contribution of the gamma background by state to the radon measurement. This gamma correction factor is simply subtracted from the calculated radon concentration.

During the 1992–1993 protocol evaluation study, the U.S. Post Office in Milledgeville, Georgia, was found to have a higher than expected gamma radiation background. Further investigation identified a certain type of building block as the reason. Concerned about the possibility that this problem may exist in other USPS buildings, HAZWRAP recommended to USPS that background gamma measurements be performed in other buildings during the pilot study. To perform the gamma background measurements, the L-LT detector sealed in a Mylar® bag was selected.

Fig. 2. The Hazardous Waste Remedial Actions Program evaluated the model S ion chamber for suitability during the pilot program.

During the pilot program, 170 gamma measurements were performed at 31 sites. Excluding the measurements in which tampering was suspected or bag failure was observed, none of the background measurements were significantly higher than the correction factors recommended by Radelec®. The recommendation is made to USPS personnel that the measurements should not be performed in the future unless high gamma background radiation is suspected.

1.5 RADON TESTING OVERVIEW

To date, 12,581 detectors have been allocated to perform radon measurements at 227 USPS sites. Project team members from ORNL and HAZWRAP placed and retrieved radon detectors at 100 USPS sites. Detectors were mailed to 127 sites for placement by USPS personnel. As of November 29, 1994, 28 sites had not placed or had not returned the detectors. The current status of radon testing at USPS sites is summarized in Appendix A. Charcoal testing data from the summer of 1992 are listed by site in Appendix B.

1.5.1 Shipment of Radon Detectors for U.S. Postal Service Deployment

Before shipping detectors to a USPS site, telephone contact was established with the Postmaster. During the initial contact, the program was explained, the level of effort was detailed, the time frame to complete the task was given, building information (e.g., address, size, number of rooms) was obtained, and a building point of contact (POC) was determined.

If the Postmaster agreed, then a package containing one radon detector for each ground-contact room, stairwell, pipe chase, elevator shaft, and other potential interfloor conduits in ground contact was shipped. Also included in the detector shipment was hardware for hanging the detectors (hooks, Velcro®, etc.), a building-specific data form for detector placement, USPS information brochures (1 per detector), and a single copy of the *U.S. Postal Service Radon Testing Guidebook*. For technical assistance, a Radon Hot Line (615-576-9343) was staffed from 8 a.m. to 5 p.m., Monday through Friday, Eastern Daylight Time.

After the detectors were placed by USPS personnel, the placement data forms were returned to HAZWRAP for data entry. If the forms were not returned within 21 working days of the date of shipment, a follow-up call was made to the site POC to determine the status of the detectors.

After receipt of the placement forms, each form was reviewed for completeness and compatibility with existing information. Any conflicts or questions were resolved by contacting the building POC.

Fourteen days before the scheduled retrieval date, a retrieval package consisting of detector retrieval data forms was mailed to the site. If the detectors were not returned within 21 days, a follow-up call was made to confirm that the detectors were removed and returned.

After the retrieval package was returned, the detectors were read and the average voltage recorded. Each retrieval form was reviewed for completeness and compatibility with existing information. Any conflicts or questions were resolved by contacting the building POC.

Along with the detectors, the *U.S. Postal Service Radon Testing Guidebook* was returned from the site once testing was completed. Each guidebook was checked for completeness, updated, and readied for future use.

1.5.2 Detector Tracking and Data Management

Based on lessons learned during the 1992-1993 protocol evaluation study, several hardware and software changes were made to the existing DMS. The following improvements reduced the detector handling cost approximately 45%:

- **Hardware improvements**
  - RS-232 E-Perm readers
    New E-Perm readers with RS-232 cables were procured and interfaced with the DMS, allowing automatic input of the voltages into the data file. This eliminated the need for manual transcription, data entry, and data entry verification of the electret voltages.
  - Bar code generator
    New bar code generators were procured, which allowed for faster generation at 10% of the previous cost.
- **Software enhancements**
  - Quality control enhancements
    With the introduction of the RS-232 E-Perm reader, data accuracy was improved. Each electret voltage is read three times. If the reading range exceeds 1 V, the software requires three new readings. Reference electret tracking alerts the user that the reader may be out of specifications.
  - On-line USPS site list
    An on-line data query system was developed to enable the user to search and obtain building and radon test results. This enables the user to answer any questions regarding radon testing for any USPS site.
  - Detector tracking
    During the validation phase, the needs for a DMS capable of tracking 400,000 radon measurement surveys were scoped. Because a radon survey of this magnitude using both reusable and consumable radon detectors has never been conducted, DMS was allowed to "grow" and adapt as needed to address specific problems. In November 1994, the lessons learned from the pilot program were incorporated into the existing DMS and are currently being evaluated. Currently, the DMS, in addition to data entry and reporting features, maintains detector chain of custody, tracks the location of each electret detector (e.g., in the field, in inventory, lost or disposed of), scheduling, tested vs nontested sites, site addresses and phone numbers, and site POCs.
  - Data query and reporting
    Based on numerous information requests made by regional USPS personnel for copies of earlier testing reports, the requirement for ad hoc radon reports was defined. Improvements were made to the reporting software that allow for the immediate generation of any site radon testing report. In addition, an on-line data query system was created that

allows the user to "navigate" to any USPS site and review the radon testing status or the data. Also, the DMS was expanded to enable all radon data to be maintained on-line for the duration of the program.

1.5.3 Quality Control

Before detector deployment began, in-depth discussions were conducted with Radelec® and others regarding potential problems with the E-Perm detectors. The objectives of these discussions were to identify potential problems and develop a quality control (QC) plan to address them. Based on these discussions, adjustments were made in the QC plan and in detector reading. For the pilot program, five types of QC radon detectors were utilized; their type and use are discussed in Sects. 1.5.3.1 through 1.5.3.5.

1.5.3.1 Laboratory Spikes

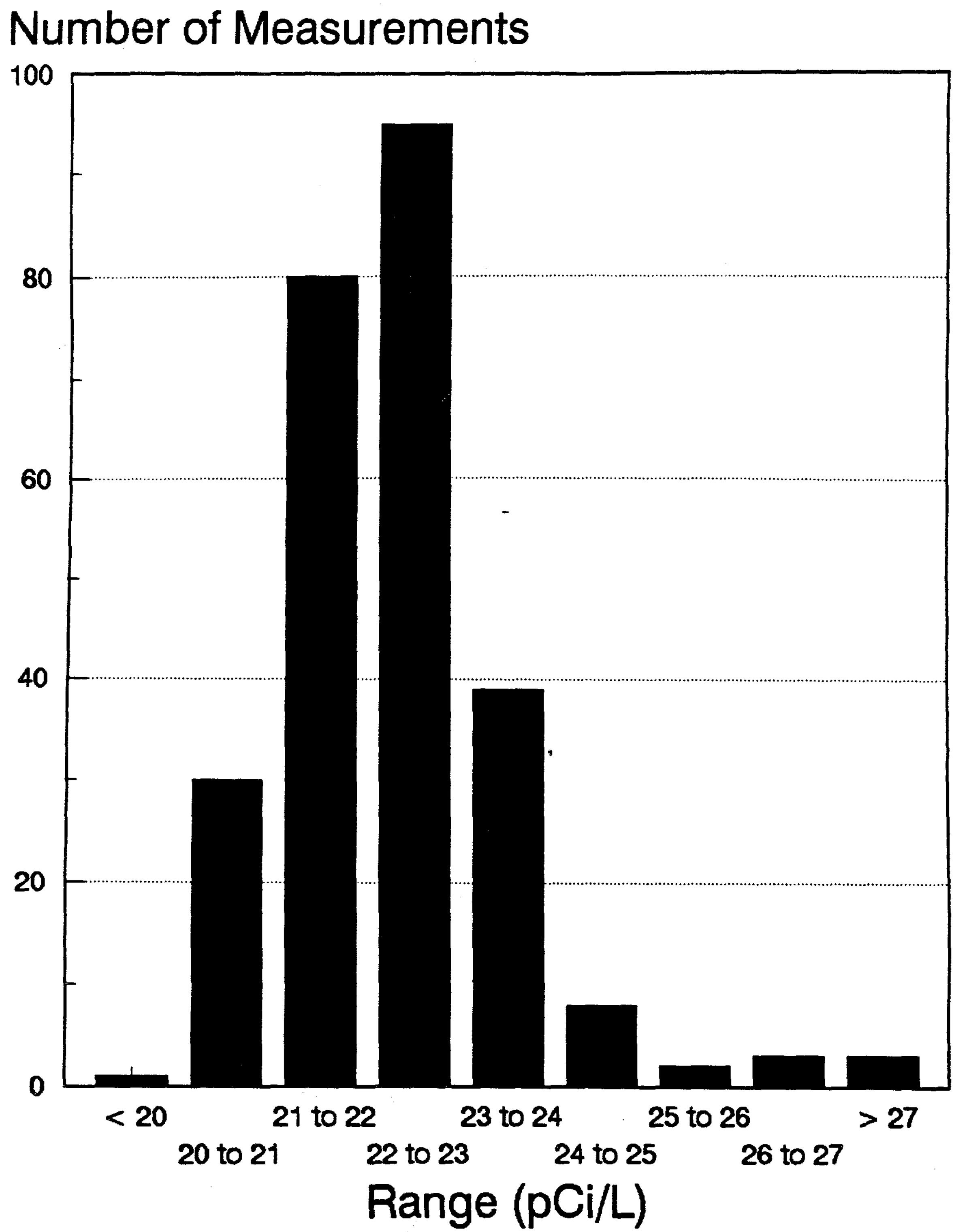
To verify detector calibration for the pilot program, 490 detector spikes (detectors exposed to a known concentration of radon) were performed at two concentrations within the ORNL Radon Calibration Facility. The first exposure was to verify the Radelec®-supplied voltage discharge curve. A total of 261 E-Perm detectors were exposed to a continuous concentration of radon (20.8 pCi/L) for 79 days. Temperature and humidity were maintained at 23°C and 50% RH for the duration of the study. The average concentration measured by the E-Perm detector was 22.3 pCi/L, with a range of 19.6 to 27.7 pCi/L and a standard deviation of 1.2 pCi/L. Figure 3 illustrates the range of the Round 1 results for the E-Perm chamber exposure.

The purpose of the second exposure was to determine the accuracy of electrets below the recommended 200-V threshold. In a large survey, a significant number of the detectors will be returned from the field under low voltage conditions. Determining the exact voltage limitations of the detectors will enable USPS to set minimum voltage requirements for electret reuse. Past studies conducted by ORNL have shown that the electret has a high error rate for final voltages below 20 V. However, some marginal success was observed for electrets in the range of 40 to 60 V. To perform this experiment, a total of 229 E-Perm detectors with an average of 348 V were exposed to a continuous concentration of radon (20.8 pCi/L) for 91 days. As before, the temperature and humidity were maintained at 23°C and 50% RH for the duration of the study. The detectors were removed after the average charge of the detectors had dropped to 44 V. The average concentration measured by the E-Perm detectors was 22.8 pCi/L, with a range of 19.5 to 26.0 pCi/L and a standard deviation of 0.9. Figure 4 illustrates the range of E-Perm results for the chamber exposure.

To verify chamber calibration, ORNL intercalibrated with the EPA Montgomery, Alabama, Radon Calibration Facility and participated in the International Chamber Exercise (ICE-1994). Results of the intercalibration are summarized in Table 2.

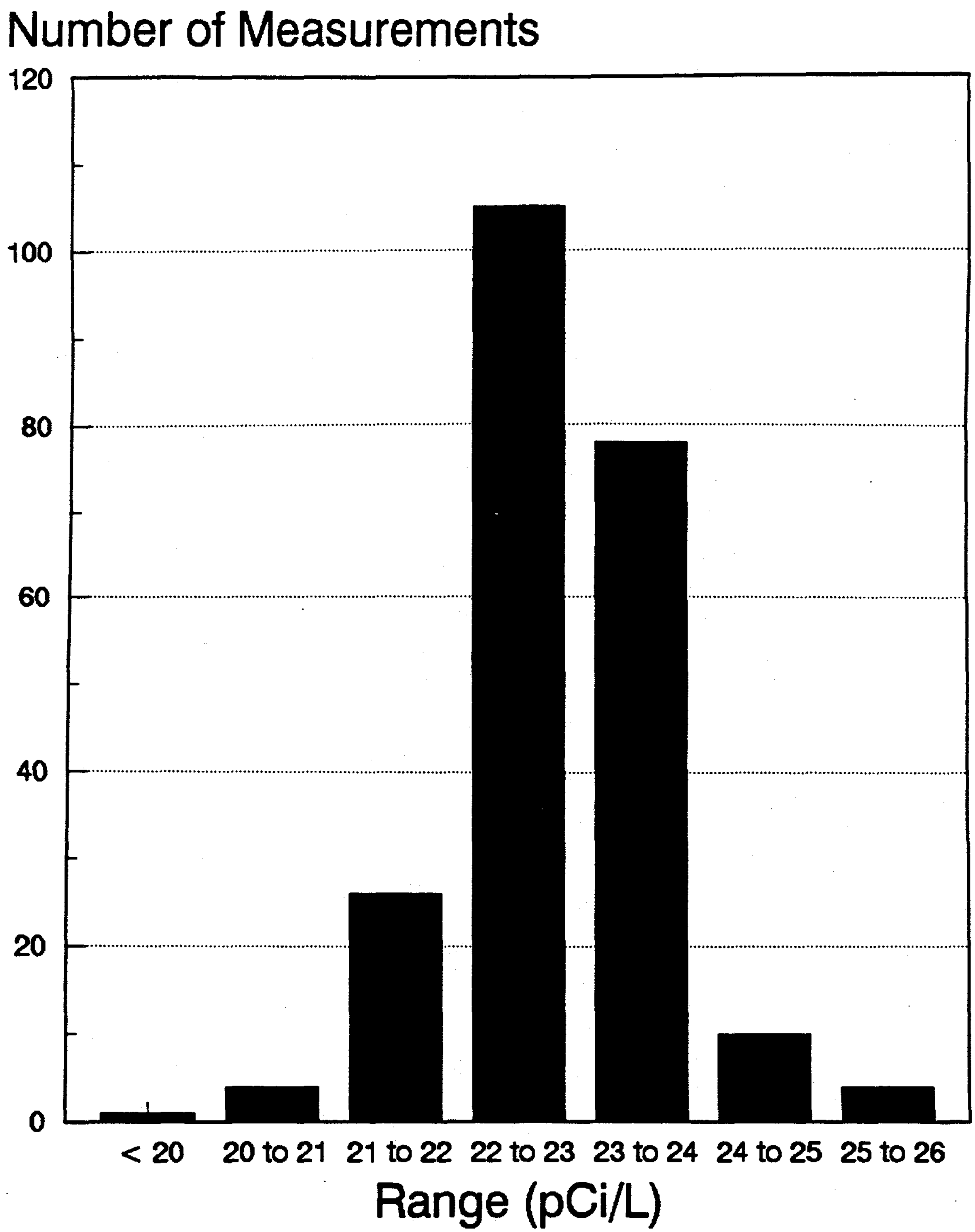
Table 2. Radon chamber intercomparisons

Date	ORNL chamber (pCi/L)	EPA Montgomery (pCi/L)	International chamber exercise (pCi/L)
August 8, 1994	22.9	N/A	23.9
September 19, 1994	17.2	18.5	N/A



Chamber mean concentration = 20.8 pCi/L
Detector mean concentration = 22.3 pCi/L

Fig. 3. E-Perm calibration distribution for Round 1.



Chamber mean concentration = 20.8 pCi/L
Detector mean concentration = 22.8 pCi/L

Fig. 4. Low-voltage E-Perm distribution for Round 2.

1.5.3.2 Laboratory Blanks

Two hundred readings were performed on randomly selected detectors during the course of the testing. These data were used to determine electret reading errors and potential discharge in handling. The average voltage difference for all 200 electrets was found to be <0.1 V, with a reader failure rate of 0.5%.

1.5.3.3 Travel Blanks

For each shipment to a USPS site, travel blank detectors were included to monitor radon exposure that might have occurred during transit. Eighty-six travel blanks were used during the survey. The average transient radon exposure was found to be <0.1 pCi/L.

1.5.3.4 Duplicate Detectors

At each site, detectors were collocated to measure field precision. A key criterion for duplicate detectors was that they be located in an area or room where the likelihood of tampering would be slight. Unfortunately, well-meaning USPS personnel relocated or returned a total of 165 duplicate detectors, believing they were placed together in error or were forgotten. Therefore, the exact number of successful duplicate measurements per site varied. During the pilot program, 563 duplicate measurements were performed. The overall field variance was estimated to be 10%. Figure 5 illustrates the duplicate measurements.

1.5.3.5 Confirmation

Because mitigation is potentially an expensive option and to determine the percentage of false positive readings, it was decided during the planning stages of the pilot program that short-term (5-day) electret follow-up measurements (model S-ST) would be performed on all single long-term readings >4 pCi/L. Based on projections, it was estimated that of the 12,000 measurements performed, fewer than 500 readings would be over the 4-pCi/L threshold. Using that assumption and data collected during the protocol evaluation study, it was estimated that 100 short-term E-Perm detectors would be needed for follow-up measurements during the pilot program. This assumption was based on 14-day average turnaround per measurement. Unfortunately, the field turnaround for the short-term confirmation detectors has been significantly longer (30 days). As of November 28, 1994, only 136 of the 1,199 planned confirmation measurements had been performed.

With respect to the percentage of false positive readings, of the 136 confirmations measurements performed, 46 or 34% of the confirmed readings were identified as false positive readings. The reasons for the high percentage are discussed in detail in Sect. 1.6.1. A listing of the completed confirmation data is included in Appendix A.

1.6 RESULTS AND DISCUSSION

For the 199 sites in which data are available (9,595 measurements), 13% of the readings were found to be elevated (i.e., >4 pCi/L). This percentage is higher than the projected 5 to 7% for several reasons: (1) sites were selected based on the high probability of finding elevated radon;

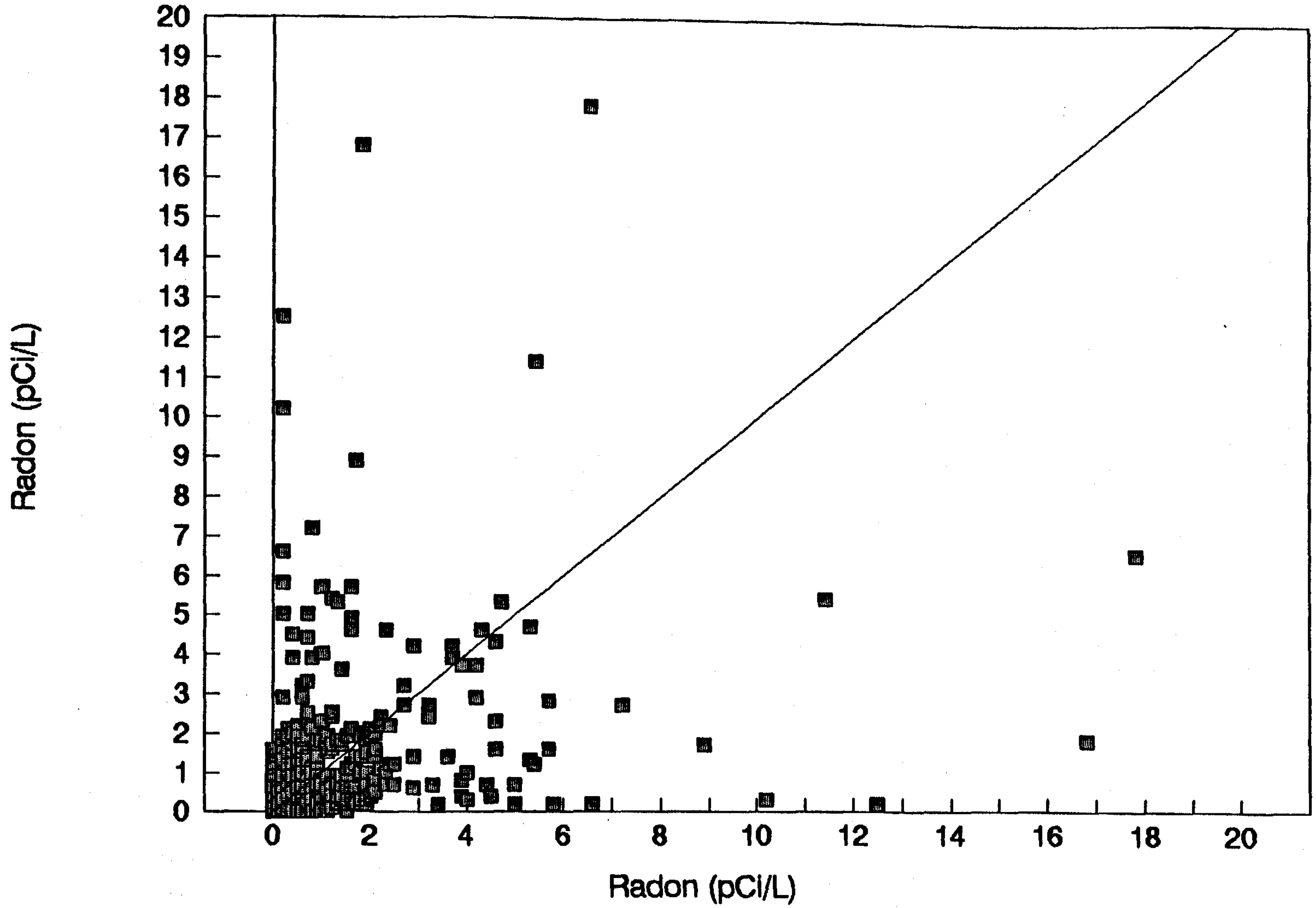


Fig. 5. Duplicate radon measurements.

(2) a previously unobserved problem with dust has given rise to a new source of false positive readings; and (3) detector tampering at some sites has resulted in false positive measurements.

1.6.1 Potential Measurement Problems

1.6.1.1 Dust Problems

During analysis of the first group of radon detectors, it was occasionally observed that the inside of the S chamber and the surface of the electret were coated with a fine layer of dust. It was further observed that detectors placed in the main mail-sort area had a higher frequency of dust inside the detector. Dust deposited on the surface of the electret can result in voltage discharge. This voltage discharge caused by dust would result in a higher reported radon concentration and potentially a false positive reading. During the 1992–1993 protocol evaluation study using the model L-LT electret, this problem was not observed because the opening for radon diffusion into the chamber is located on the side of the detector, as opposed to the top of the S chamber. Dust is suspected to be the leading cause of the high percentage of false positive readings. Currently, discussions are under way with Radelec® to determine whether the existing filters in the S chambers can be replaced with a higher mesh filter or if procedural modifications can be made to reduce electret exposure to dust.

1.6.1.2 Detector Tampering

During the 1992–1993 protocol evaluation study, tamper tape was used on all detectors. Of all of the detectors that had damaged tape, <10% were suspected to be intrusive tampering. Apparently the tamper tape was the object of tampering, not the detector. Because installing tamper tape costs roughly $0.20/detector or potentially $80K for the full-scale program, it was decided to conduct the pilot study without the benefit of the tape to determine whether the percentage of actual tampering was significantly different. During the 1992–1993 survey with the tamper tape, the percentage of actual tampering was estimated to be 15%. The pilot study had a tampering percentage of 13%. Therefore, it appears that the percentage of detector tampering is constant with or without the tamper tape. If the current policy of 100% follow-up for all elevated readings is maintained, the conclusion is that no net benefit will result from using the tamper tape because all readings will be verified before corrective action is taken.

1.6.1.3 Attrition Rate

During the 1992–1993 protocol evaluation study, a majority of the detectors were secured to objects (e.g., pipes, walls) using wire, hooks, Velcro®, etc. Whenever possible, the detectors were located out of reach (e.g., 7 to 8 ft from the floor). This resulted in an average deployment rate of approximately 30 detectors per hour for a 2-person field team. For the pilot study, the detectors were mostly placed on out-of-the-way objects and not secured. Using this method of placement, the average time for detector deployment increased to 48 detectors/hour for a 2-person field team. The attrition rate using this method was comparable, 5.3% for unsecured detectors vs 8% for secured detectors. Therefore, securing a detector did not improve its "chance of survival." Table 3 provides the best method for detector placement in USPS building areas.

Table 3. Recommended radon placement per U.S. Postal Service building area

Area	Location of placement
Mail lobby/high-traffic hallway	Secure the detector to ceiling or wall a minimum of 8 ft from the floor
Workroom	Secure the detector to a support column a minimum of 8 ft from the floor
Vacant rooms	Place the detector unsecured on an object off of the floor
Occupied offices	Place the detector unsecured on an out-of-the-way object
Storage/mechanical rooms	Place the detector unsecured on an out-of-the-way object
Enclosed loading docks	Secure the detector to a support column or wall a minimum of 8 ft from the floor
Breakrooms	Place detector in an out-of-sight location
Locker rooms/bathrooms	Place detector in an out-of-sight location

1.6.1.4 Detector Reuse

To complete the USPS Radon Testing and Mitigation Program, HAZWRAP projects upward of 400,000 radon measurements. Detector procurement cost potentially would represent half or more of the entire program expenditures. If single-use detectors (such as alpha tracks) were used, the combined unit cost for the detector and analysis would be approximately $8. This would represent a total procurement cost of $3.2M. Using reusable detectors, such as the E-Perm, can possibly lower the per-measurement cost for the main program. Figure 6 illustrates the condition of the electret population after an average of two field exposures. Table 4 provides a summary of the data.

Table 4. Summary of electret population condition

Item	Value
Number of electrets	5,054
Average voltage for new population	734 V
Number of field exposures	2 (average 93.4 days each)
Average total exposure	187 days
Average discharge per exposure	36 V
Number of consumed electrets	334
Total losses	666 (5.3%)
Projected number of readings remaining in electrets	15

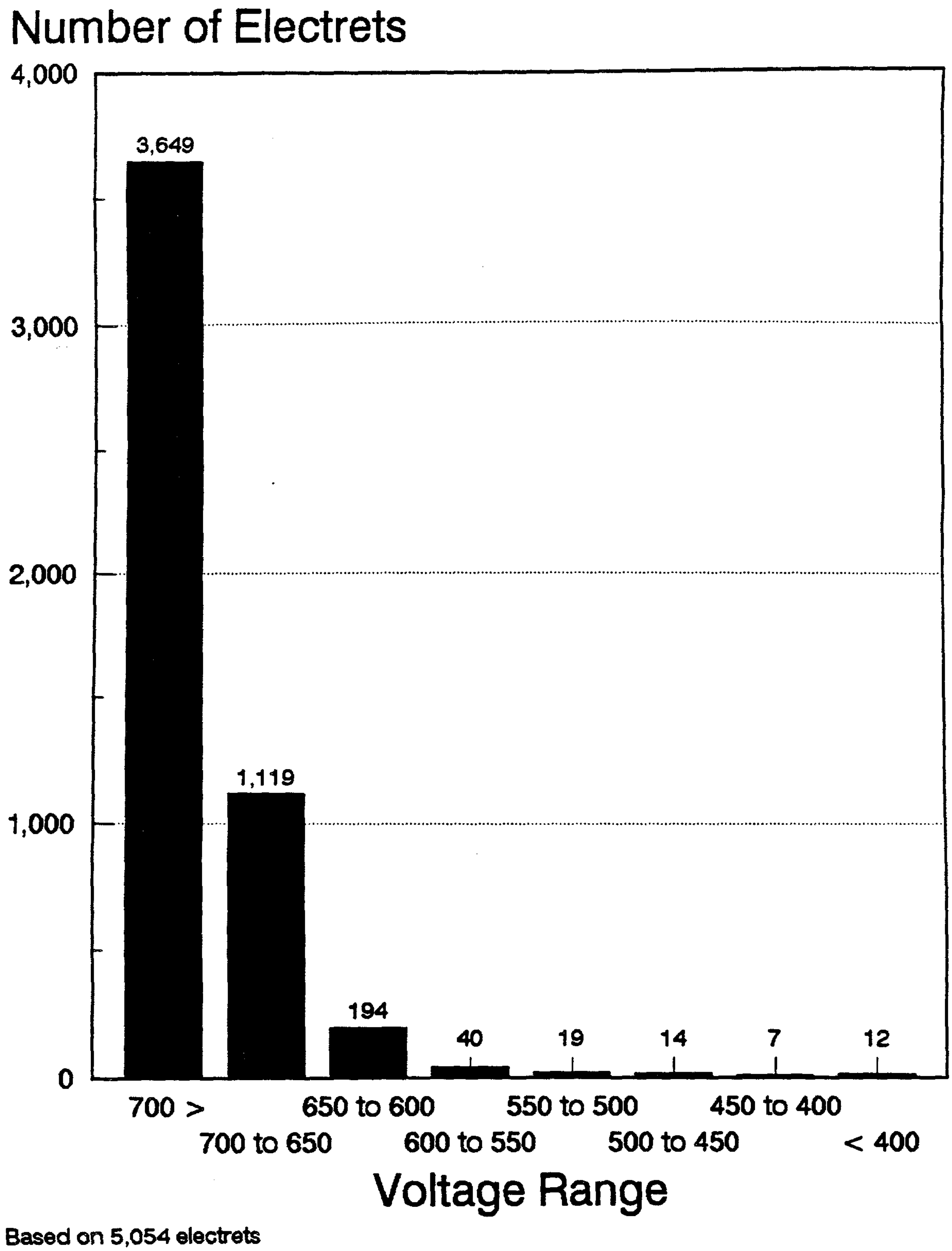


Fig. 6. Status of electret voltage.

Based on the current consumption and loss rate, projections indicate that for the course of the program (e.g., 400,000 measurements), the average detector measurement cost would be $4.50/measurement. If the $1.50 analysis cost is included with the cost of the detector, the total cost per measurement using E-Perm detectors would be approximately $6/measurement. Currently, alpha track detectors in large quantity cost approximately $8/measurement. Therefore, using the E-Perm system may potentially save USPS $800K over the course of the program.

1.7 RECOMMENDATIONS

Although significant progress was made during the pilot program, several new problems have arisen that may impact the full program. The detector loss rate should be reduced. For every 0.5% reduction in detector losses, the cost per measurement would drop by $0.20. Also, the dust problem should be addressed. A 34% false positive rate (due in large part to dust) would result in an additional 20,000 follow-up measurements in the full program. The cost for material and labor alone would add approximately $300K to the overall program cost. Additional work is needed to identify a cost-effective method to prevent the detector's exposure to dust. In addition, more work is needed in the area of tamper reduction. Fluorescent dyes (invisible in normal light) may help to verify whether a detector has been opened.

2. RADON MITIGATION DIAGNOSTIC PROTOCOL FOR U.S. POSTAL SERVICE FACILITIES

2.1 INTRODUCTION

During the past 10 years, considerable progress has been made in the field of residential radon mitigation. Six years ago, as required by IRAA, EPA established regional radon mitigation centers that train and certify private contractors in residential radon mitigation proficiency. As a result, the mystique of residential mitigation has diminished considerably along with mitigation cost ($2500 in 1983 vs $1200 in 1994).

Another change over the past 11 years has been the reduction in the amount of residential radon mitigation diagnostics. In the early 1980s, a typical mitigator would perform on average half a day of mitigation diagnostics in a typical home in order to select and design an effective mitigation system because the mitigation hardware technology (e.g., mitigation fans) was not very effective. This hardware limitation mandated that the mitigation system be placed in the optimum location (site optimization) to ensure success. By 1994, however, the power of available mitigation hardware increased significantly; therefore, the need for site optimization has been reduced. Also, in most areas of the country, sufficient historical mitigation data exist that suggest mitigation could be achieved without using extensive diagnostics. For example, during the past 2 years, a mitigation company in central Pennsylvania has been advertising guaranteed radon mitigation for any 1955 or newer house with a slab for $1200 using subslab depressurization as the mitigation method. This price is quoted and guaranteed without the benefit of mitigation diagnostics or preinspection. On the surface, it appears that the company is taking significant risk. However, success is ensured for this company because local building codes have required a standard size and amount for subslab aggregate, and hundreds of homes in this geographical area have been successfully mitigated using the advertised method. If the current trend continues in the advancement of mitigation hardware and as local mitigation methods become more standardized, the performance of residential mitigation diagnostics will substantially decrease within the next 10 years.

The absence of mitigation diagnostics, however, will not be true for large buildings. To illustrate this point, a typical house is rather simple in design and construction (e.g., single substructure and mechanical system), and radon mitigation for a typical house is inexpensive. Large buildings, on the other hand, contain components that could potentially complicate mitigation reduction measures (e.g., multiple mechanical systems and substructures). In addition, the mitigation hardware currently available, although sufficiently powerful for residential applications, could potentially be overextended in large buildings. Other considerations in large buildings are the capital outlays for radon reduction. On a per-structure basis, radon reduction in large buildings costs considerably more than that in residential buildings. Currently, for active subslab mitigation measures, a working estimate is $\$1/ft^2$ of ground-contact area. Therefore, a 100,000-ft^2 building would cost approximately $100K to mitigate using active subslab mitigation.

Another consideration for large-building mitigation is the long-term cost of mitigation. Most radon mitigation measures require energy (e.g., electricity) to operate or result in increased heating or cooling cost (energy penalty). Selection of the best mitigation method is essential for keeping energy costs under control. In addition, the mitigation measure for a large building must take into account the people who work within the space. If the mitigation measure results in a decrease in employee comfort, productivity may suffer. All of these considerations must be addressed to achieve radon reduction at a reasonable cost.

2.2 OVERVIEW OF RADON MITIGATION

The radon mitigation training offered by the U.S. Environmental Protection Agency Regional Training Centers (USEPARTCs) is designed for private mitigation contractors. The training provides participants with the knowledge to mitigate single, detached residential housing. For the USPS radon program, selected personnel will be responsible for the mitigation of thousands of postal facilities. Unfortunately, the existing training offered by USEPARTCs provides little information for the managers of large mitigation programs. In addition, with the exception of limited exposure to radon mitigation in schools, little information is available for large-building mitigation. USPS-wide, the potential cost for radon mitigation activities will be millions of dollars. If poor mitigation choices are made, maintenance and upkeep costs during the remaining lifetime of those buildings could also cost millions of dollars.

Radon mitigation is divided into two basic categories: passive and active. Passive mitigation is defined as a nonmechanical means of radon abatement or control. Examples of passive mitigation include sealing cracks, balancing an existing mechanical system, or increasing the natural ventilation rate of the building substructure (e.g., crawl space). For the remaining lifetime of the building, passive radon techniques are generally considered the most cost-effective means of radon control. Typically, installation costs for a passive system are less than half those of an active system, and a passive system has no maintenance and operation cost (i.e., energy for operation). Unfortunately, successful passive mitigation has proven difficult because all radon entry pathways within a structure must be identified and negated.

Active mitigation entails the use of mechanical means, such as a fan, to control radon entry into the living area. Generally speaking, all active mitigation methods can be grouped into two categories: preentry and postentry mitigation. Preentry mitigation is a technique that retards radon entry into the living area. Typical examples are shell pressurization (SP), subslab depressurization (SSD), and submembrane depressurization (SMD). SP, the oldest radon mitigation method, retards radon entry by mechanically introducing sufficient outdoor air to induce a positive pressure across the slab and into the soil. For buildings with slabs or basements, SSD is a common means of radon control. In this method, a pipe with a fan attached is inserted through the slab. When the fan is activated, the area beneath the slab (subslab) is depressurized. The resulting depressurization prevents radon entry into the living area by redirecting the subslab radon into the pipe for discharge into the atmosphere. For buildings with crawl spaces, SMD is usually employed. By placing a plastic sheet on the floor of the crawl space and depressurizing underneath the plastic sheet using a fan, radon can be collected and discharged into the atmosphere away from the building.

Postentry mitigation involves the treatment of the contaminated air inside the building. Charcoal absorption, for example, removes radon from the air by entrapment in an activated charcoal bed. Heat recovery ventilation (HRV) involves the exchange of contaminated indoor air with fresh uncontaminated outdoor air. Other active mitigation methods are described in *Radon Reduction Techniques for Detached Housing* (EPA/625/5-87/019).

2.2.1 Considerations in Large-Building Radon Mitigation

Current research has indicated that large buildings may contain construction features or mechanical systems that would inhibit the installation or operation of a residential-type mitigation system. Examples are return air ducts or supply ducts that are routed through the slab. These mechanical components have demonstrated sufficient subslab perturbation to overpower traditional SSD systems. Also, highly segmented slabs were found to disrupt SSD fields (Wilson et al. 1991).

Other important issues for consideration during mitigation design are health, safety, and local building code requirements. For example, the best method for mitigation of a building might be SSD, but the presence of asbestos in building material might prevent the installation of the polyvinyl chloride (PVC) intake and exhaust piping. Local fire codes are a factor as well. To prevent the release of toxic fumes in the event of a fire, within certain areas of the country, PVC pipe cannot penetrate into occupied areas or through fire walls. Also, roof penetrations for radon exhaust may invalidate the contractor's warranty. All of these factors and more must be considered during the mitigation design.

2.2.2 Room Isolation and Relocation

By definition, radon mitigation is the measure taken to reduce human exposure to elevated levels of radon. As stated previously, elevated radon measurements within large buildings can be isolated in certain areas of a building. If these areas are occupied on a regular basis, then mitigation should be considered. But, before corrective action is taken, another option should be considered. The key part of the risk associated with radon exposure is that a person must be exposed to be considered at risk. Obviously, if no exposure occurs, no human health risk exists. Thus, by restricting or removing a worker from exposure, a more cost-effective mitigation may result. For example, by limiting or controlling access to a room (i.e., locking the door) or relocating occupants to safer areas within the building, the human health risks are eliminated and mitigation has occurred.

2.2.3 Cost Considerations

At the 1992 EPA Radon Conference in Minneapolis, Minnesota, the average mitigation cost for large buildings was estimated to be as high as \$1 to \$2 per ft^2. However, the installation cost of radon mitigation should not be the only consideration; future costs, such as the energy penalty and system upkeep, are factors as well. In private residences, the cost of operating and maintaining most mitigation systems has been estimated at less than \$500/year for most areas of the United States. In large buildings, however, this cost could run as high as tens of thousands of dollars per year if mitigation entailed the use of unconditioned air for increased building ventilation. Because of the potential installation and lifetime operation costs involved, radon mitigation in large buildings can be a major investment. Matching the right system with the right building is essential to control both current and future costs.

2.2.4 Limitation of Existing Mechanical Systems

When dealing with radon in large buildings, the temptation exists to adjust and/or modify the existing mechanical system to increase the building ventilation rate. However, this type of corrective action must be performed with considerable caution. For example, the most typical response has been to increase the building ventilation rate by increasing the amount of fresh-air uptake. This approach has been successful, provided the existing system was designed to condition the extra volume of outside air. In cases where the system was not able to handle the increased air uptake, an overall decrease in the building comfort index resulted. Examples of the problems noted have been drastic changes in the building humidity, temperature variability, higher mold and spore counts (i.e., building flu), and substantially increased energy consumption. Also, radon mitigation by performing minor mechanical balancing has been shown to be an ineffective means of long-term radon control. Studies by EPA indicate that the blockage of one supply duct could result in system imbalance. If mitigation is to be performed by this method, a qualified mechanical engineer should be consulted before action is taken.

2.2.5 Phase 2 Protocol Development

In June 1992, USPS requested HAZWRAP to begin the preliminary development of the Phase 2 interim radon mitigation diagnostics protocol. The final diagnostics protocol, according to USPS instructions, contained or addressed the following issues:

- To the best extent possible, the protocol must make use of existing methods and procedures found within the private sector or be of sufficient detail so that they can be readily transferred.
- The methods specified in protocol must be conducted in such a way as not to interfere with normal USPS operations or conflict or violate existing USPS health and safety rules or requirements.
- The protocol should provide clear mitigation choices.

After the acceptance of the Phase 2 scope by USPS, a sufficient number and types of USPS facilities with elevated radon were visited and the proposed protocol implemented. After each set of buildings, USPS and HAZWRAP reviewed the collected data and decided to continue, refine, or terminate the protocol development.

In response to the request by USPS, HAZWRAP submitted for USPS approval a two-step outline in July 1992. The letter detailed the methods and research requirements needed to develop a Phase 2 radon mitigation protocol. Briefly, the proposed USPS mitigation diagnostics protocol is as follows:

Step 1: Perform a radon test in all ground-contact rooms, stairwells, pipe chases, and other interfloor conduits. Record the results on the building floor plan and classify the radon data pattern as one of the following types:

- Random (no distinct pattern),
- Clustered (grouped together in a certain area of the building),
- Linear (results are in a row), and
- Uniform (all data are about the same).

With the radon room map, review the building construction plans, noting any building features, modifications, or additions that would enhance radon entry.

The building should then be divided into diagnostics zones of the following types: slab, interior, or mechanical. A slab diagnostics zone is area beneath the slab enclosed by footers or foundation. An interior diagnostics zone is area defined by rooms enclosed by fire walls or masonry construction. Consideration should be given to normal room door positions (open or closed) when defining this type of zone. A mechanical diagnostics zone is defined only if a forced-air system is present. For each forced-air mechanical system, locate the supply and return ducts. Identify the supply air zone(s) and return air zone(s). In a properly balanced system, the zones should overlap. Note any duct work that is in contact with the ground or that passes through low ventilated or confined areas in contact with soil such as crawl spaces or storage rooms.

A visual walk-through inspection of the building should then be conducted to confirm the accuracy of the building plans and to collect information on individual room usage and occupancy patterns. If available, information on the building heating, ventilation, and air conditioning (HVAC) system and the duty cycle should be noted as well. After the walk-through inspection, an interview of the building maintenance staff should be conducted to review the collected information and discuss future diagnostics work. The Postmaster should also be interviewed to collect information on the future plans for the USPS building including renovations or expansions.

Step 2: From the data and information collected in the first step, active mitigation diagnostics are then performed within each of the identified zones, and a mitigation design is developed for each zone. Examples of active diagnostics are shell leakage, shell air-exchange rate, subslab permeability, SSD field extensions, and mechanical system balance determination. During the active diagnostics, all interzonal communications, such as subslab field extensions or interzonal mixing of different tracer gases, must be noted. If two zones communicate, then it may be advantageous to combine them into a single zone for corrective action. After completion of the diagnostics, a composite mitigation design for the building or zone is developed.

2.2.6 Radon Mitigation Diagnostics Utilized for Evaluation

In the 1992 proposed mitigation protocol, HAZWRAP proposed the use of four basic radon mitigation diagnostic techniques: episodic air change for HRV, blower door test for SP, subslab pressure field extension, and subslab permeability testing for SSD mitigation.

2.2.7 Episodic Air Change Diagnostics

Episodic air change is used to measure the turnover rate of air within a room or building. Tracer quantities of Freon-12 are injected into the building or room, and the rate of loss of the tracer is monitored as a function of time (hours). By calculating the inverse slope of the natural logarithm vs time in hours, the air change rate per hour (ACH) of the area sampled can be estimated.

A building or room's ventilation rate or ACH is very important from both economic and health standpoints. Ventilation is defined as the summation of the volume of infiltrating outside air and the volume of exhausting inside air across the building shell as a function of time. Ideally, to minimize energy cost, a building with a low ACH would be desirable. However, the breathing process of a building retards the buildup of moisture and indoor air pollutants that may cause health problems. To provide a healthy and comfortable indoor environment, the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) recommends various air turnover rates determined by the space's usage. For example, a minimum rate of 0.35 ACH is recommended (ASHRAE 62-1989, Tables 2.1–2.3) for single-family dwellings while rates for chemical laboratories can be as high as 18 ACH.

Low air change rates result in the buildup of high levels of radon, carbon monoxide, carbon dioxide, and nitrogen oxides from normal daily routines such as cooking, smoking, and working. In addition, because of the out-gassing of consumer products, unacceptably high levels of carcinogens, such as formaldehyde, chlorinated solvents, and hydrocarbons, may be present as well. Another problem with low ACH is the increase in humidity within the living or work area. The result is a "musty smell" usually caused by elevated mold and spore concentrations. Exposure to these biogens has been linked to headaches and respiratory, sinus, and other health problems. Potentially, elevated radon may be the least of the health problems within certain USPS buildings.

The only practical way to solve an indoor air quality problem within a building is to increase the ventilation rate. One approach is to install an intake fan and import fresh air. Another is to install a whole-building fan to periodically remove the air from the building. Both approaches have some drawbacks. Importation of nonconditioned fresh air has a considerable energy and comfort penalty. Whole-building fans tend to depressurize the structure, which increases radon infiltration. The third possibility for increased ventilation is to install an HRV system, which is a packaged unit complete with blower fans, controls, and air-to-air heat exchanger. Filtered and desiccated fresh air is brought into the living area from outdoors, and stale air is removed. This swapping of air results in an increase in the building air change, thus lowering the concentration of indoor pollutants. In the process, heat energy is transferred from the warmer to the cooler air stream. This heat exchange or energy recovery results in saving heating costs in the winter and cooling costs in the summer. Energy recovery can be as high as 80% in some of the newer HRV units. For example, if the desired ventilation flow for better indoor air quality was 100 ft^3/min, the energy penalty would be approximately that of 20 ft^3/min of unconditioned fresh air.

Radon, like other indoor air pollutants, can be controlled by better ventilation. However, because of economical limits on the quantity of conditioned air that can exchanged, HRV has a very finite range of application in radon abatement. EPA has provided in *Radon Reduction Techniques for Detached Housing* (EPA/625/5-87/019) an algorithm to estimate the amount of air required for effective mitigation. The algorithm is as follows:

1. Calculate the volume of the building or room.

   [square footage (ft^2) × ceiling height (ft^3)] = Volume

2. Estimate or measure the existing air exchange rate and ventilation rate (if unknown).

   Range of ACH
   - Energy efficient: 0.3
   - Average: 0.50
   - Old wood frame: 0.80

   ACH × cubic volume (ft^3) × 1 hour/(60 minutes) = ft^3/min

3. Calculate the required reduction factor.

   Current radon level (pCi/L)/desired radon level (pCi/L).
   (Note: For most applications, assume 2 pCi/L to be the desired radon level.)

4. Calculate the total air input needed for mitigation.

   Reduction factor × current ventilation rate (ft^3/min) = total air input (ft^3/min)

5. Calculate the required air flow for HRV.

   Total air input (ft^3/min) − current ventilation rate (ft^3/min) = required HRV (ft^3/min)

2.2.8 Blower Door Diagnostics

Blower door diagnostic tests measure the leakiness of a building or room's envelope or shell. The principle of the measurement is that as pressure across the shell increases, the air flowing through cracks and crevices will increase in an attempt to balance the induced pressure. Based on the flow and pressure data collected, one can calculate the average shell leakage under certain conditions. To perform the measurement, the blower door frame and fan are inserted into the door frame of a room or exterior door. By adjusting the speed of the fan, both fan and shell pressures at different settings can be measured. The fan pressure is proportional to the amount of air removed (ft^3) from the building per minute (ft^3/min). The shell pressure is proportional to the area of leakage present within the building.

One of the most common reasons for radon entry into a building is the slight positive pressure present beneath the slab relative to that in the living area. If the radon flux is great enough, this pressure differential pulls radon soil gas through the cracks and crevices, resulting in elevated radon. Radon infiltration and subsequent buildup have been observed with a pressure differential as small as 1 Pascal (250 Pa = 1 in. water). This imbalance can be reversed if sufficient air, typically 4 Pa, is introduced into the building or room, resulting in a positive pressure relative to the subslab pressure. However, wind and other environmental factors require nonstressed pressure of 8 Pa for effective long-term mitigation. Pressurization mitigation systems are also highly dependent on maintaining an airtight seal across the structural shell. Cracking a window or an outside door will result in the loss of pressure. In some cases, a loss of only 1 to 2 Pa will defeat the purpose of a pressurization radon mitigation system. Also, air exhaust systems within the building, such as bathroom or range fans and clothes dryers, would defeat a pressurization system.

2.2.9 Subslab Field Extension Test for Subslab Depressurization Mitigation

The pressure field extension test (PFET) is an integral part in the design of an SSD system. The test measures the lateral extent of a depressurization field at a given vacuum beneath the slab. In general, for an SSD system to be successful, the system pressure field, or more precisely the vacuum field, should cover at least 75% of the subslab surface area. To accomplish this, multiple penetrations in different areas of the slab are usually required. By performing PFET, a determination can be made for the number of SSD points and minimal vacuum requirements required for mitigation. To conduct PFET, a 1.5-in. diagnostic hole is drilled along the center line of the slab. Six to ten perimeter field extension holes (3/8 in.) are drilled at varying distances (1 to 20 ft) from the diagnostic hole. Using a small, variable-speed, industrial vacuum cleaner, a constant vacuum of 500 Pa (2-in. WC) is applied across the slab. The vacuum field extension is then determined by measuring the quantity of vacuum present in the 3/8-in. holes as a function of distance from the diagnostic hole. Ideally, the depressurization field extends radially beneath the slab around the diagnostic hole, with the fringe limits being defined as areas with less than 2 Pa of vacuum. By measuring the radius of extension and measuring a circle around the diagnostic hole, the extent of SSD is estimated.

A subslab permeability test is usually performed in conjunction with PFET. During the design of an SSD system, proper fan selection is critical for long-term continuous performance. A typical error most contractors make is the selection of a fan with too high a flow demand for a given pressure. For all mitigation fans, minimal air flows need to be maintained to keep the fan motor cool. Fan manufacturers provide fan performance curves (pressure vs flow) that indicate minimal flow requirements at a given pressure. A subslab permeability test measures the ease at which air moves through the aggregate/soil beneath the slab (i.e., flow for a given vacuum). This property of porous materials is called permeability. To measure permeability beneath a slab, it is necessary to record the flows through a slab penetration at different degrees of depressurization. As in PFET, a 1.5-in. hole is drilled through the slab. A measurement stand, consisting of 1-in. pipe in a wooden flange, is inserted into the hole. A small, variable-speed, industrial vacuum cleaner evacuates the subslab air through the 1-in. pipe in which an anemometer (air velocity meter) and a micromanometer (pressure meter) are installed. By varying the speed of the small, variable-speed, industrial vacuum cleaner, the flow required to produce a given pressure can be measured. An *xy*-data plot of the data pairs can then be used to select the proper fan for the SSD system.

2.2.10 Building Flow and Pressure Mapping

Under ideal conditions, all zones in a large building with a forced-air system are under neutral or slightly positive pressure with respect to the outdoors. If all zones within the building have identical pressure with respect to the outdoors, the system is called balanced. If this is not true, the forced-air system is called imbalanced. An imbalanced forced-air system results in higher operating costs and may decrease occupant comfort. If the imbalance results in certain zones being depressurized with respect to the outdoors, increased radon entry into the zone is the result.

In theory, all forced-air systems are balanced when initially installed. Over time, however, the system may become imbalanced for a number of reasons: building modification, changes in the mechanical system, system performance degradation, occupant tampering, and lack of maintenance. To determine system balance, the flow of each room supply duct is measured using an instrument called a flow hood. A flow hood consists of a pressure sensor and a nylon hood placed over a register. The pressure measured by the meter is proportional to the exhaust flow measured in cubic feet per minute. If the combined flow into a zone in cubic feet per minute is divided by the cubic volume of the zone (ft^3), the zonal Flow per Volume Factor (FVF) is calculated.

However, if FVF is used as a means of forced-air system balancing, caution must be exercised. In a homogenous zonal building (e.g., all zones are identical), all zones should have similar FVF. However, in nonhomogeneous cases, some areas of the building may have a higher FVF as a result of its usage or the number of people occupying the area. Depending on the degree of occupancy and usage of the zone, ASHRAE recommends minimal zonal ventilation rates. In most cases, this is based on a fixed amount of flow (ft^3/min) per person under a specific working environment. For example, in a USPS facility, the main mail sort room should have a higher FVF than a small, private office because more people work within that area. Therefore, using FVF as a means of achieving system balancing may reduce the overall air quality in a work area.

Another way of determining system balance is to measure individual room pressure relative to the outdoors [differential pressure (DP)]. This measurement is obtained by using an electronic micromanometer with <1 Pa sensitivity. To perform the measurement, a reference DP measurement is made from one area to the outside. All other areas are then measured sequentially relative to the last area measured. Once normalized to the outdoors, all room DP measurements should be neutral (e.g., DP = 0) or positive and should be within 1 to 2 Pa of each other.

2.2.11 Continuous Radon Measurements

Numerous studies have shown that indoor radon levels are rarely constant. Changing external environmental factors (such as external temperature, rain, wind, and barometric pressure) can change the indoor radon concentration by as much as an order of magnitude in a few hours. In large buildings, other factors, such as mechanical duty cycle and room usage, can also have an impact on the radon concentration. For example, to save energy cost, an HVAC system that maintains a high ACH rate in the building during normal work hours will reduce that ventilation rate by a factor of 4 or 5 during the night. If the daytime levels of radon are 2 pCi/L, then the night levels maybe as high as 10 pCi/L. Passive radon detectors, such as the E-Perm, average the concentration of radon over a period of time. Therefore, the average passive measurement for the building would be >4 pCi/L. If the building is unoccupied during this time of elevated radon, then no mitigation would be needed. Another example is a high radon measurement in a vault. During the day while the vault door is open, the room's ACH rate and radon level are comparable to those in the room in which the door is open. However, during the night when the vault door is closed, the ACH rate could drop as much as 2 orders of magnitude, resulting in a similar increase in the radon level. Again, a passive detector would indicate a problem when personnel are not being exposed to elevated radon.

To diagnose these types of problems, an active radon measurement or continuous measurement is performed. The instrument used for these types of measurements must have good sensitivity ($\pm$0.2 pCi/L), be able to perform the measurement at an interval of 1 hour or less, and have the ability to record the measurement as a timed event. If a measurement is performed, the radon concentration (y-axis) is plotted vs time in hours (x-axis). A comparison of the duty or usage cycle is then performed. For best results, a minimum of 48 hours is required for this type of measurement.

2.2.12 Initial Evaluation of the Mitigation Diagnostics Protocol

In 1993, at the request of USPS, HAZWRAP performed an initial evaluation of the mitigation diagnostic protocol at four sites: Allentown, Pennsylvania; Pueblo, Colorado; Big Spring, Texas; and Okmulgee, Oklahoma. The initial study indicated that all of the mitigation diagnostics were needed to determine a cost-effective mitigation solution. Also, the recommendation was made that additional studies be performed on a more diverse population of buildings to determine any weaknesses in the protocol. A more detailed review of the findings are reported in *Radon Levels and Diagnostics at 38 U.S. Postal Service Sites* (DOE/HWP-140).

2.3 ADVANCED EVALUATION OF MITIGATION DIAGNOSTICS PROTOCOL

In June 1993, a meeting was held between the GSA and USPS to discuss elevated levels of radon in GSA out-leased space in USPS-owned buildings. GSA expressed an interest in the USPS performing radon mitigation in GSA out-leased buildings in which radon had been measured >4 pCi/L. USPS also committed to GSA that the mitigation would be performed based on the recommendations of an on-site mitigation evaluation. USPS also committed to GSA to perform mitigation diagnostics at 18 USPS sites with out-leased GSA tenants during 1994.

In January 1994, USPS tasked HAZWRAP to perform further evaluations of the proposed mitigation diagnostics protocol at 18 GSA out-leased sites and 4 USPS sites. In addition to the evaluation, HAZWRAP was to provide a draft protocol at the completion of the testing and recommend the best mitigation diagnostic methods. The sites for the 1994 diagnostic study are listed in Table 5.

Table 5. Sites for 1994 radon mitigation diagnostics study

Location	Mitigate	GSA out-leased site
Abilene, Texas	Yes	Yes
Ada, Oklahoma	Retest	Yes
Clovis, New Mexico	Retest	Yes
Dallas, Texas	Retest after HVAC system installed	Yes
Eastport, Maine	Yes	Yes
Eldora, Iowa	Yes	Yes
Enid, Oklahoma	No	Yes
Florissant, Missouri (leased)	No	No
Griffin, Georgia	Manage in place	Yes
Lancaster, Ohio	Yes	Yes
Lowville, New York	Yes	Yes
Machias, Maine	Yes	Yes
Marion, Indiana	Yes	Yes
Paris, Kentucky	Yes	Yes
Raton, New Mexico	Yes	Yes
Rockland, Maine	Yes	Yes
Scott City, Kansas	No	Yes
Talladega, Alabama	Yes	Yes
Watertown, New York (163 Arsenal Road)	Closed	No
Waynesville, North Carolina	No	No
Willimantic, Connecticut (leased)	Retest	No
Wrightsville, Georgia	Yes	Yes

2.4 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN ABILENE, TEXAS

The main post office in Abilene, Texas, located at 314 Pine Street, was constructed in 1936. The four-story building had one addition in 1964. The substructure consists of a one-level basement subdivided with concrete walls. The 154,560-ft^2 building has a total of 11 HVAC forced-air systems. Heating is provided by a hot water exchanger, while cooling is provided by chilled water. In August 1993, 156 short-term radon measurements were performed by USPS. A total of two measurements were >4 pCi/L.

Mitigation diagnostics were performed by the HAZWRAP team in May 1994. The diagnostics performed at the site are listed in Table 6.

Table 6. Mitigation diagnostics summary at the U.S. Post Office in Abilene, Texas

Diagnostic test	Number of tests	Comments
Air change	17	
Blower door	Not completed	No suitable doorway
Subslab	Part 1 completed Part 2 completed	7 tests
Continuous radon measurements	21 measurements	Elevated radon detected
Flow hood	Not completed	Safety (ceiling too high)
Radon entry measurements	9	0 to 6 counts per minute
Pressure mapping	107	Lower floors (negative) Upper floors (positive)

During the continuous radon measurements, elevated radon was detected in two unoccupied storage rooms (B004 and B022). Both rooms have no windows or ventilation. However, radon concentration changes were a function of the HVAC day/night cycle: lower during the day and higher at night. All other rooms were found to be <4 pCi/L. Table 7 summarizes the continuous radon measurements for the site.

Table 7. Summary of continuous radon measurements for the U.S. Post Office in Abilene, Texas

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	0.8	Room B006
02	1.0	Basement supply office
03	4.2	Room B022
04	4.3	Room B004
05	0.3	Postmaster's office
06	0.4	Breakroom
07	0.5	Basement wood shop
08	0.8	Basement Room 001
09	0.9	Room 2109
10	0.7	Room 2317
11	0.4	Main room (front center)
12	0.6	Main room (center)
13	0.8	Boiler room
14	0.9	Basement shop
15	1.2	Room B003
16	0.7	Main room
17	0.4	Main room
18	0.2	Main room
19	0.9	Room B012
20	0.8	Room 001
21	0.7	Room 2202

Air change measurements were performed in various rooms in the building. The HVAC day/night duty cycle indicates significant differences between night and day ACH rates as a function of HVAC operation (Table 8).

Table 8. Air change measurements at the U.S. Post Office in Abilene, Texas

Room number	Instrument number	Air change (hour^{-1})	Comments
B001 south	1A/4855	0.21	No ventilation
B001 north	1A/9346	0.07	No ventilation
B102	101/2377	0.13	HVAC off
Main room north	1A/4855	0.04 0.11	HVAC off HVAC on
Main room south	1A/6346	0.29 0.17	HVAC on HVAC off
B102	101/2377	0.49	HVAC on
Main room north	1A/4855	0.32	HVAC on
Main room south	1A/9346	0.36	HVAC on
Postmaster's office	101/2377	0.05	HVAC off
2113	1A/4855	0.17	HVAC off
Postmaster's office	101/2377	0.26	HVAC on
2113	1A/4855	0.32 0.04	HVAC on HVAC off
2320	101/2377	0.12 0.44 0.26 0.10	HVAC off HVAC on HVAC on HVAC off
2320	101/2377	0.26 0.14	HVAC on HVAC off

Subslab diagnostics were performed at multiple locations throughout the basement. The data (Table 9) indicate good subslab field extension.

Table 9. Subslab field extension data for the U.S. Post Office in Abilene, Texas

Hole 1.45 (in.)	Location	Field extension (ft.)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Basement	15	11	1/4 to 1/2 gravel	4
2	Basement	20	13	1/4 to 1/2 gravel	4
3	Basement	10	11	1/4 to 1/2 gravel	4
4	Basement	20	11	1/4 to 1/2 gravel	4
7	Basement	15	11	1/4 to 1/2 gravel	4
8	Basement	10	11	1/4 to 1/2 gravel	4
9	Basement	9	11	1/4 to 1/2 gravel	4

Radon entry pathway diagnostics identified no major entry pathways into the building. The results are listed in Table 10.

Table 10. Radon entry pathway diagnostics for the U.S. Post Office in Abilene, Texas

Hole type	Location	Counts per minute
Wall-to-floor joint	B102	6
Door joint	Basement freight elevator	3
Floor crack	Basement	4
Electrical outlet	Basement	4
Floor joint	Basement supply area	4
Floor joint	Basement	3
Drain	Boiler room	1
False-floor joint	Boiler room	0
Door joint	Basement passenger elevator	2

During the diagnostic tests, a DP map of the building was performed. The data indicated that the basement and first floors are under negative pressure, while the second, third, fourth, and fifth floors were found to be under positive pressure. DP data are listed in Table 11.

Table 11. Differential pressure measurements for the U.S. Post Office in Abilene, Texas

Location	Differential pressure relative to outdoors (Pa)
Basement	**Basement**
Basement	-4
Breakroom	-6
Maintenance support room	-6
Hallway (basement)	-7
AH-1	-4
B003	-6
B006	-6
B008	-8
B012	-6
B014	-6
B016	-6
B020	-7
B024 (stairwell)	-6
First Floor	**First Floor**
Entry	0
Lobby	1
1001	1
1005	-1
1009	-1
Postmaster's office	-1

Table 11 (continued)

Location	Differential pressure relative to outdoors (Pa)
Manager of operations	3
Conference room	-1
Bathroom	-1
Customer relations	0
Workroom	2
Men's restroom	2
Women's restroom	3
Second Floor	**Second Floor**
Stairwell 1	0
Hallway	2
2000	3
2000A	2
2001 Stairwell 2	4
2002	2
2004	3
2005	2
2006	4
2007-8	4
2010	2
2012	2
2013	4
Bathroom	-1
2101	4
2102	4

Table 11 (continued)

Location	Differential pressure relative to outdoors (Pa)
2103	3
2104	4
2105	3
2106	2
2107	2
2108	3
2109	0
2110	4
2111	-1
2112	3
2113	2
2201	2
2202	2
2203	3
2205	3
2207	2
2208	3
2209	4
2210	2
2211	1
2301	2
2302	3
2304	3

Table 11 (continued)

Location	Differential pressure relative to outdoors (Pa)
2305	3
2306	0
2308	0
2308-B	1
2310	0
2311	1
2312	0
2313	0
2314	0
2315	2
2317	4
2318	0
2319	2
2320	-2
2321	3
2324	-1
2326	2
2401	3
2402	2
2403	1
2404	4
Third Floor	**Third Floor**
Hallway	1

Table 11 (continued)

Location	Differential pressure relative to outdoors (Pa)
3002	8 (suspect)
3003	-1
3004	3
3006	10 (suspect)
3008	19 (suspect)
3009	4
3010	2
3011	4
3012	2
3014	4
3101	3
3103	4

Blower door measurements could not be performed because of the lack of a suitable exterior door. Flow hood measurements could not be performed because of the high ceiling and vent design.

Based on data collected, the primary mitigation attempt should be the installation of passive vents in the doors for Rooms B004 and B022. The estimated mitigation cost would be approximately $200. If that attempt is unsuccessful, the addition of a small intake fan (75 to 150 ft^3/min) above each door exhausting into the rooms should increase the ventilation sufficiently for mitigation. The estimated cost for the secondary mitigation attempt would be $450.

2.5 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN ADA, OKLAHOMA

The main post office in Ada, Oklahoma, located at 131 E. 13th Street, is a four-story building constructed in 1935. The substructure consists of a slab on grade (90%) and crawl space (10%). The approximately 40,000-ft^2 building has multiple HVAC forced-air systems. Heating is provided by electricity and a hot water exchanger, while cooling is provided by air compression. The fresh air intakes are located on the roof of the building.

In August 1992, 28 short-term radon measurements were performed at the site by USPS personnel. None of the results were found to be above the 4-pCi/L action level. In June 1994, the mitigation diagnostics were performed on the site by the HAZWRAP team. The diagnostics performed by the team are summarized in Table 12.

Table 12. Mitigation diagnostics summary for the U.S. Post Office in Ada, Oklahoma

Diagnostic test	Number of tests	Comments
Air change	12	
Blower door	1	
Subslab	Part 1 completed Part 2 completed	
Continuous radon measurements	16 measurements	No elevated radon detected
Flow hood	Not completed	Vents inaccessible
Radon entry	5	1 to 9 counts per minute
Differential pressure	32	Basement neutral, 1st floor negative, 2nd floor positive

Sixteen continuous measurements were performed in various rooms in the building. No elevated radon was detected. The continuous radon measurements are summarized in Table 13.

Table 13. Summary of continuous radon measurements for the U.S. Post Office in Ada, Oklahoma

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	0.9	Pump room
02	0.8	Storage room
04	1.3	Maintenance office
05	0.4	Postmaster's office
06	0.7	Office supply room
07	0.2	Breakroom
08	0.6	Boiler room
11	0.6	Room 232
13	0.7	Main room (front)
14	0.6	Main room (back left)
15	1.0	Room 204
16	0.6	Main room

Table 13 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
17	0.5	Main room
18	0.5	File room
19	0.6	Room 215
21	0.7	Main room

Air change measurements were performed in various rooms in the building. The data indicate significant differences between night and day ACH rates as a function of the HVAC cycle (Table 14).

Table 14. Summary of air change measurements for the U.S. Post Office in Ada, Oklahoma

Room number	Instrument number	Air change (hour^{-1})	Comments
Basement storage	101/4855	0.40	Air conditioning on
Breakroom	1A/9346	0.34	Air conditioning on
Boiler room	1A/2377	0.48	No ventilation
Basement storage	101/4855	0.04 0.23	Air conditioning off Air conditioning on
Breakroom	1A/9346	0.19	Air conditioning off
Boiler room	1A/2377	0.52	No ventilation
Postmaster's office	101/4855	0.49	Air conditioning on
Main room west	1A/9346	0.37	Air conditioning on
Main room east	1A/2377	0.64	Air conditioning on
Postmaster's office	101/4855	0.09 0.40	Air conditioning off Air conditioning on
Main room west	1A/9346	0.07 0.27	Air conditioning off Air conditioning on
Main room east	1A/2377	0.12 0.50	Air conditioning off Air conditioning on

A single subslab diagnostic was performed in the basement. The data (Table 15) indicate excellent communication beneath the slab.

Table 15. Subslab field extension data for the U.S. Post Office in Ada, Oklahoma

Hole 1.45 (in.)	Location	Field extension (ft)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Basement	40+	5.5	0.125 to 0.5 gravel	4

Radon entry pathway diagnostics did not identify any major entry pathways. The data are provided in Table 16.

Table 16. Radon entry pathway data for the U.S. Post Office in Ada, Oklahoma

Hole type	Location	Counts per minute
Drain	Basement boiler room	1
Wall	Basement pump room	1
Electrical outlet	Basement boiler room	0
Open area	Crawl space	1
Gravel	Crawl space	9

DP measurements in the building found that the basement area was under negative pressure. The results are listed in Table 17.

Table 17. Differential pressure measurements for the U.S. Post Office in Ada, Oklahoma

Location	Differential pressure relative to outdoors (Pa)
Basement storage	-3
Pump room	-4
Office storage	-5
Maintenance storage	-9 (suspect)
Maintenance office	-3
Back hallway	-4
Crawl space	-5
Front hallway	-5

Table 17 (continued)

Location	Differential pressure relative to outdoors (Pa)
Breakroom	4
B-1	-4
Entry	-1
Lobby	1
Main room	0
Assistant Postmaster's office	0
Postmaster's office	0
Men's restroom	-1
Women's restroom	-3
Stairwell	5
Hallway	5
201	5
204	5
208	5
215	5
219	4
220	3
221	4
228	2
229	2
232	3

Flow hood measurements could not be performed because of the design of the supply vent. Although the blower door test was performed, the data were inconclusive because of the large size of the building and the amount of customer traffic.

Since the last radon measurements were taken (1992), the HVAC system has been replaced with a new system. Because no elevated radon was detected during the mitigation diagnostics, it is suspected that the new HVAC system corrected the problem identified by GSA. The recommendation is made that confirmatory long-term measurements be performed in the near future to confirm the absence of elevated radon.

2.6 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN CLOVIS, NEW MEXICO

The main post office in Clovis, New Mexico, is located at 405 Gidding Street. The two-story building was constructed in 1966 and has a slab-on-grade substructure. The 11,858-ft^2 building has one HVAC forced-air system. Heating is provided by a hot water exchanger, while cooling is provided by chilled water. The fresh air intakes are located on the roof of the building.

In August 1992, 34 short-term measurements were performed by USPS personnel. One measurement (7.0 pCi/L) was found to be above the action level. A follow-up 1-year electret measurement (1992–1993) conducted by USPS personnel confirmed the presence of elevated radon at the site.

In May 1994, the HAZWRAP team performed mitigation diagnostics at the site (Table 18).

Table 18. Mitigation diagnostics summary for the U.S. Post Office in Clovis, New Mexico

Diagnostics test	Number of tests	Comments
Air change	11	
Blower door	Not completed	No suitable exterior doorway
Subslab	Part 1 completed Part 2 not completed	Fractured sand base, not suitable for subslab mitigation
Continuous radon measurements	19 instruments	No elevated levels of radon detected
Flow hood	Not completed	Height, size of vent
Radon entry pathway	11	0 to 13 counts per minute
Differential pressure	14	Positive pressure

During the diagnostics, 19 continuous radon measurements were collected in various areas of the building. None of the readings were >4 pCi/L. The continuous radon measurement data are summarized in Table 19.

Table 19. Summary of continuous radon measurements for the U.S. Post Office in Clovis, New Mexico

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	0.5	CFS office
02	0.5	Supervisor's office

Table 19 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
03	0.2	Main room
04	0.4	Main room
05	0.8	Postmaster's office
06	0.4	Main room
07	0.4	Main room
08	0.3	Back sort room
09	1.1	Room 240
10	0.8	Room 216
11	0.9	Room 270
12	1.0	ACSC office
14	0.7	Shop
15	0.9	Room 207
16	1.0	Bulk mail office
17	0.5	Electrical and mechanical room
18	0.5	Room 252
19	0.9	Maintenance office
20	0.8	Side sort room
21	0.9	Room 260

Air change measurements were performed in various rooms in the building. The data indicate significant differences between night and day ACH rates as a function of the HVAC cycle (Table 20).

Table 20. Air change summary for the U.S. Post Office in Clovis, New Mexico

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
260	101/4855	0.19	Air conditioning on
Main room	1A/9346	0.37	Air conditioning on

Table 20 (continued)

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Superintendent's office	1A/2377	0.52	Air conditioning on
260	101/4855	0.20	Air conditioning off
Main room	1A/9346	0.29	Air conditioning off
Superintendent's office	1A/2377	0.34	Air conditioning off
260	101/4855	0.34	Air conditioning on, door open
Main room	1A/9346	0.47	Air conditioning on
216–218	1A/2377	0.36	Air conditioning on
235	101/4855	0.39	Air conditioning on
216–218	1A/2377	0.30	Air conditioning on

Radon entry pathway diagnostics were also performed at the site. No significant entry pathways were identified. The entry pathway data are listed in Table 21.

Table 21. Radon entry pathway data for the U.S. Post Office in Clovis, New Mexico

Hole type	Location	Counts per minute
Slab joint	Side sort room	5
Wall-to-floor joint	Side sort room	5
Drain	Janitor's closet (off main room)	2
Electrical outlet	Back sort room	1
Electrical outlet	Main room (front left)	4
Drain	Mechanical room	1
Drain	Boiler room	2
Wall-to-floor joint	Boiler room	2
Drain	Boiler room	0
Electrical outlet	Maintenance office	3
Electrical outlet (floor)	Superintendent's office	13

DP measurements were also performed at the site. However, no conclusive trends were noted. The DP data are listed in Table 22.

Table 22. Differential pressure measurements for the U.S. Post Office in Clovis, New Mexico

Location	Differential pressure relative to outdoors (Pa)
First Floor	**First Floor**
Front lobby	-2
Customer counter	1
Main room	-2
Side lobby	-7 (suspect)
Central forwarding	0
Second Floor	**Second Floor**
Hallway	0
204	2
207	8 (suspect)
214	4
235	0
260	-4
Back stairwell	-3

Inspection of the subslab diagnostic hole revealed a dry, compacted sand as the subslab material. Materials such as this have a tendency to dry out and crack. Over time, these subslab material cracks tend to network to the outside. A vacuum, when applied to this type of material in this state, will not flow radially but will flow the path of least resistance along the channels created by the cracks. The subslab diagnostics revealed substantial communication to the outside, meaning that the cracks have penetrated the foundation. Because SSD mitigation is dependent on radial field extension, not channeling, it was concluded that the subslab material was highly fractured and ill-suited for SSD mitigation.

The blower door test could not be performed because of the absence of a suitable exterior door. The flow hood measurements could not be performed because of height restrictions and supply vent design.

Because of the absence of the previously detected elevated radon and no plausible explanation, it is recommended that a heating season measurement be performed to determine whether the radon is a seasonal problem. If these measurements confirm a seasonal problem, then SP would be the primary mitigation method. This would require an upgrade of the building shell (e.g., sealing of windows and doors, addition of an airlock at the main and back entrances), and the installation of an additional HVAC 10,000-ft^3/min unit. The additional HVAC unit should be sufficient to maintain a pressure of 5 to 8 Pa in the lower floor of the building. The cost of the SP mitigation system is estimated to be $72.5K (includes other building modifications). Because of the type of subslab material and the already high ACH rate, there are no other conventional mitigation methods. However, a depressurized floor plenum system (an airtight subfloor installed on top of the existing slab) depressurized at 8 to 10 Pa could be installed in the effective areas at a cost of $15/ft^2.

2.7 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN DALLAS, TEXAS

The downtown post office in Dallas, Texas, located at Bryan and Ervey Street, is a five-story building constructed in 1929. The substructure consists of a one-level basement and is subdivided with concrete walls. The approximately 212,970-ft^2 building is serviced by multiple HVAC forced-air systems (exact number unavailable). Heating is provided by hot water exchange, while cooling is provided by chilled water. The fresh air intakes are located on the roof of the building. At the time of Phase 2 diagnostics, the old HVAC systems were being replaced. In August 1992, USPS personnel conducted a total of 165 short-term radon measurements in the building. Two measurements, both in the basement, were >4 pCi/L.

In May 1994, the HAZWRAP team conducted the Phase 2 mitigation diagnostics. Table 23 summarizes the mitigation diagnostics.

Table 23. Summary of mitigation diagnostics performed at the U.S. Post Office in Dallas, Texas

Diagnostic test	Number of tests	Comments
Air change	17	
Blower door	Not completed	No suitable exterior doorway
Subslab	1 test	
Continuous radon measurements	21 measurements	
Flow hood	18	73 to 1001 ft^3/min
Radon entry pathway	13	0 to 11 counts per minute
Differential pressure mapping	15	All negative results (unit installation incomplete)

Twenty-one continuous radon measurements were performed in the building. None of the measurements were >4 pCi/L. The continuous radon readings are summarized in Table 24.

Table 24. Summary of continuous radon measurements for the U.S. Post Office in Dallas, Texas

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	1.8	Room 17
02	0.6	Manager's office
03	0.7	Room 26 (August 1992 reading: 8.7 pCi/L)
04	1.4	Room 24A
05	1.5	Room 22A
06	1.8	Room 53
07	0.3	Breakroom
08	1.1	Room 28
09	0.8	Computer room
10	0.7	Main room (east center)
11	0.6	IRS storage room
12	0.8	Room 20
13	0.8	Room 45
14	0.7	Main room (west center)
15	1.3	Room B-31 (August 1992 reading: 4.0 pCi/L)
16	0.9	Main room (front center)
17	0.7	Main room (center)
18	0.5	Basement near chiller
19	0.7	Room 10A
20	1.1	Room 21A
21	0.9	Basement shop

Air change measurements were performed in various rooms in the building. The data indicate significant differences between night and day ACH rates as a function of the HVAC cycle (Table 25).

Table 25. Air change summary for the U.S. Post Office in Dallas, Texas

Room number	Instrument number	Air change (hour^{-1})	Comments
Main room	1A/2337	0.26	Air conditioning on
Main room	1A/9346	0.21	Air conditioning on
102	101/4855	0.21	Air conditioning on
Main room	1A/2337	0.36	Air conditioning on
Main room	1A/9346	0.36	Air conditioning on
161	101/4855	0.32	Air conditioning on
Basement shop	1A/9346	0.52	Air conditioning off
Basement shop	1A/9346	0.58	Air conditioning on
230	101/4855	0.27	Air conditioning on
B-31	1A/9346	0.08	Air conditioning off
230	1A/9346	0.15	Air conditioning off
B-31	1A/9346	0.86	Air conditioning on
240	101/4855	0.35	Air conditioning on
240	101/4855	0.22	Air conditioning off

Subslab diagnostics were performed in the basement. The results (Table 26) indicate excellent communication beneath the slab.

Table 26. Subslab field extension data for the U.S. Post Office in Dallas, Texas

Hole 1.45 (in.)	Location	Field extension (ft)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Basement shop	30	3.5	0.5 to 2 river rock	2.5

Radon entry pathway diagnostics measurements did not indicate any significant entry pathways. The data are listed in Table 27.

Table 27. Radon entry pathway data for the U.S. Post Office in Dallas, Texas

Hole type	Location	Counts per minute
Drain	Room 21-A	1
Wall	Room 21-A	7
Wall	Room 22-A	4
Wall	Room 21-B	5
Elevator shaft	Basement freight elevator	2
Floor joint	Stairwell	1
Wall-to-floor joint	Room 28	4
Drain	Room 32	0
Drain	Boiler room	2
Wall	Boiler room	11
Drain	Boiler room	6
Wall	Maintenance office	4
Elevator shaft	Basement passenger elevator	7

Flow hood measurements indicate that the flow is balanced for most of the rooms tested. The data are listed in Table 28.

Table 28. Flow hood measurements for the U.S. Post Office in Dallas, Texas

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Room 157-A	245	259
Room 161	281	286
Room 161	269	298
Room 167-B	295	309
Room 167-B	247	261
Room 111	227	249
Postigue	73	67
Postigue	397	412
Room 230	269	282

Table 28 (continued)

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Room 230	216	222
Room 230	659	672
Room 230	161	172
Room 240	261	263
Room 240	583	617
Room 240	486	500
Room 240	242	263
Room 240	608	638
Room 240	927	1001

The blower door mitigation diagnostics could not be completed because a suitable exterior door was not available.

Although the radon problem appears to be resolved, the problem may reoccur in the future. During the 1992 Phase I inspection, inadequate ventilation in certain areas of the basement was noted and substantiated during the Phase 2 ACH measurements (Table 25). Because the HVAC system is being replaced, the ventilation system should be expanded to include all basement rooms. The basement should be retested after the HVAC installation is complete.

2.8 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN EASTPORT, MAINE

The main post office in Eastport, Maine, is a three-story building constructed in 1890. The substructure consists of a one-level basement subdivided with mostly concrete walls. The approximately 8,500-ft^2 building has no HVAC or heating and air conditioning (HAC) forced-air systems. Heating is provided by hot water exchanger, while cooling is not provided. During 1992–1993, ten 1-year radon measurements were performed by USPS personnel. Six of the ten measurements were found to be >4 pCi/L.

In July 1994, the HAZWRAP radon mitigation diagnostic team performed radon mitigation diagnostics at the site. Table 29 summarizes the mitigation diagnostic data.

Table 29. Radon mitigation diagnostics at the U.S. Post Office in Eastport, Maine

Diagnostics test	Number of tests	Comments
Air change	3	Windows open during the day
Blower door	Not completed	No suitable exterior door

Table 29 (continued)

Diagnostics test	Number of tests	Comments
Subslab	Not completed	No plans; subslab utilities and slab was more than 10 in. thick
Continuous radon measurements	13 measurements	1 measurement >4 pCi/L
Flow hood	Not completed	No forced-air system
Radon entry pathway	8	Lowest reading: 2 counts per minute Highest reading: 11 counts per minute
Differential pressure	10	Weather problems

During the diagnostics, 13 continuous radon measurements were performed. One measurement, boiler room, was found to be >4 pCi/L. The windows were open during the day of the test periods. Table 30 summarizes the data.

Table 30. Summary of continuous radon measurements for the U.S. Post Office in Eastport, Maine

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	0.9	Postmaster's office
02	3.0	Customs office (back)
04	2.5	Customs office (front)
05	0.4	Coast guard berthing 2
06	0.7	Main room (center)
07	0.5	Coast Guard operations room
08	1.6	Maintenance office
09	0.1	Coast Guard mess room
12	0.4	Coast Guard berthing 1
16	0.7	Main room (back)
18	1.5	Basement bathroom

Table 30 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
19	20.3	Oil tank room
21	3.0	Boiler room

Air change measurements were performed in various rooms in the building. The data indicate significant differences between night and day ACH rates as a function of windows being open or closed (Table 31).

Table 31. Air change summary for the U.S. Post Office in Eastport, Maine

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Main room	1A/4855	0.87	Windows open
Main room	1A/4855	0.74 0.16	Windows open Windows closed
Main room	101/2377	0.34 0.07	Windows open Windows closed

No major entry pathways were identified during the radon entry pathway diagnostics. However, the testing was incomplete because of an instrument malfunction that occurred during the diagnostics. It is important to note that a large, ground-contact hole (approximately 3 × 3 ft) was discovered in the floor of the oil storage tank room after the instrument malfunction. Although no entry pathway data are available, it is suspected that this hole is a major radon entry pathway into the room. The data are listed in Table 32.

Table 32. Radon entry pathway measurements at the U.S. Post Office in Eastport, Maine

Hole type	Location	Counts per minute
Wall vent	Basement bathroom	8
Drain	Boiler room	6
Wall	Boiler room	2
Chimney	Boiler room	11
Wall-to-floor joint	Storage room	2
Floor	Customs back office	8

Table 32 (continued)

Hole type	Location	Counts per minute
Electrical outlet	Maintenance room	8
Wall	Electrical room	5

DP measurements were complicated by open windows and by variable wind speed and direction. The data listed in Table 33 are approximate averages. These significant negative DP measurements indicate that the building shell must be tight.

Table 33. Differential pressure measurements for the U.S. Post Office in Eastport, Maine

Location	Differential pressure relative to outdoors (Pa)
Entry	-5
Customs office	-5 (variable)
Tank room	-5 (variable)
Boiler room	-6
Hallway	-6
Bathroom	-6
Maintenance	-4
Storage room	-5
Electrical room	-6
First Floor	**First Floor**
Lobby	-4
Main room	-4
Postmaster's office	-4
Second Floor	**Second Floor**
Stairway	-3
Hallway	-1
Berthing 2	-1

Table 33 (continued)

Location	Differential pressure relative to outdoors (Pa)
Head	-3
Operations	-2
Rec. room	-2 (suspect)
Mess	-2 (suspect)

Three mitigation diagnostics could not be performed because of construction or design restrictions. The blower door measurement could not be performed because the windows were open at the site and a suitable exterior door was not available. Because the building did not have a forced-air system, the flow hood measurement could not be performed. Because of the presence of subslab utilities and the absence of building plans, diagnostics were not performed for safety reasons. It is important to note that even if the plans had been available, the thickness of the slab (10 in.) would have prevented successful drilling.

Radon mitigation of the U.S. Post Office in Eastport, Maine, is complicated by several factors that would prevent the installation of a traditional radon mitigation system. For example, the building is listed as a national historic site, which places severe restrictions on the number of modifications that can be made to the exterior. For example, the addition of an SSD exhaust pipe on the exterior wall would be prohibited. Also, because the roof is both decorative and pitched, it would be impossible to place a mechanical unit on it. Placing the mechanical units on the ground next to the building might detract from the building's architectural lines.

In the oil tank room, a 3- × 3-ft sewer access hole is in the slab. The hole is in direct contact with the soil and is an obvious entry pathway for radon into the room. The first mitigation attempt should be to fill in the hole with concrete. Once completed, radon testing should be performed to determine whether a reduction has occurred. The estimated cost for this type of mitigation would be $300. If the passive mitigation attempt is unsuccessful, then four HRV units with a 750-ft^3/min capacity each should be installed in each quarter of the basement. Each unit should be set for 100% intake and 75% exhaust to ensure a positive reading. Supply and exhaust ducting will have to be added to each room in the basement to ensure adequate air circulation. Intake locations for all HRV units should be located on the grass knoll area to prevent intake of car exhaust. HRV exhaust should be at ground level at the most convenient location. The estimated cost for this mitigation is $30K.

2.9 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN ELDORA, IOWA

The main post office in Eldora, Iowa, is a two-story building constructed in 1939. The substructure consists of a one-level basement. The basement is subdivided with mostly concrete walls. The approximately 9,500-ft^2 building has one HAC forced-air system located on the roof that services the main floor only. On the main floor, heating is provided by a hot water exchanger, while cooling is provided by a compressor. There is no forced-air system in the basement; cooling is provided by window air conditioning units.

During 1989, GSA personnel performed two 30-day radon measurements, which were both >10 pCi/L. In August 1992, USPS personnel performed a total of 13 short-term measurements. None of the measurements were >4 pCi/L.

In June 1994, radon mitigation diagnostics were conducted by the HAZWRAP team. The mitigation diagnostic data are summarized in Table 34.

Table 34. Mitigation diagnostics summary for the U.S. Post Office in Eldora, Iowa

Diagnostics test	Number of tests	Comments
Air change	4	Poor basement ventilation rate
Blower door	Not completed	No suitable exterior doorway
Subslab	Part 1 completed Part 2 completed	Good field extension
Continuous radon measurements	14 measurements	No readings >4 pCi/L
Flow hood	Not completed	Ceiling too high (safety)
Radon entry pathway	6	5 to 19 counts per minute
Differential pressure	Basement: 12 First and second floors: 10	Negative pressure Negative pressure

During the mitigation diagnostics, 14 continuous radon measurements were performed. Although all of the data average <4 pCi/L, some of the single night readings were >10 pCi/L in some rooms. This increase in radon concentration is consistent with the cycle of the building air conditioning system. The continuous radon measurement data are summarized in Table 35.

Table 35. Summary of continuous radon measurements for the U.S. Post Office in Eldora, Iowa

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	2.9	Room 4
02	3.4	Copy room
03	2.3	Room 11
04	3.1	Room 5
05	2.5	Room 9
06	3.1	Room 1

Table 35 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
07	2.6	Room 2
08	3.4	Room 3
10	0.6	Main room
12	0.6	Main room
15	2.3	Room 6
17	0.4	Upstairs
18	2.1	Storage off boiler room
20	0.4	Main room

Air change measurements were performed in various rooms in the building. The data indicate significant differences between night and day ACH rates as a function of the HVAC cycle. The data are summarized in Table 36.

Table 36. Air change summary for the U.S. Post Office in Eldora, Iowa

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Basement 3	101/9346	0.08	Window air conditioning unit on
Main room	1A/4855	0.24 0.08	Air conditioning on Air conditioning off
112	1A//2377	0.02	No ventilation
Main room	1A/4855	0.22 0.10	Air conditioning on Air conditioning off

Subslab diagnostic measurements were performed in the boiler room located in the basement. The data in Table 37 indicate good field extension beneath the slab.

Table 37. Subslab field extension data for the U.S. Post Office in Eldora, Iowa

Hole 1.45 (in.)	Location	Field extension (ft)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Boiler room	20	8.5	0.5 gravel	3.5

Radon entry pathway diagnostics did not locate any major pathways. The data are summarized in Table 38.

Table 38. Radon entry pathway diagnostics for the U.S. Post Office in Eldora, Iowa

Hole type	Location	Counts per minute
Crack in pipe	Storage under stairs	4
Phone jack	Boiler Room 6	5
Phone jack	Conference Room 9	9
Phone jack	Room 5	5
Phone jack	Conference Room 3-B	13
Phone jack	Room 1 Iowa ext. office	19

DP measurements indicate that the building is under negative pressure. The room DP data are listed in Table 39.

Table 39. Differential pressure measurements for the U.S. Post Office in Eldora, Iowa

Location	Differential pressure relative to outdoors
Basement	**Basement**
Stairwell	-4
Hallway	2
2	0
3	-2
4	-2
5	-3
6	1
9	1
11	1
Storage room	-3
Stairwell	-3

Table 39 (continued)

Location	Differential pressure relative to outdoors
First Floor	First Floor
Entry	-4
Main room	-5
Lobby	-5
Postmaster's office	1
Women's restroom	-5
Stairwell	-8
Second Floor	Second Floor
Right room	-9
Left room	-9

Two planned diagnostics could not be performed: (1) the blower door diagnostic could not be performed because the exterior door was not suitable, and (2) the flow hood measurements could not be completed because of the ceiling height.

Because of the configuration of the air conditioning unit, it is possible that effective radon control is being maintained by the air conditioning unit during summer months. Once the air conditioning system is deactivated, it is likely that radon levels will increase. Short-term testing during the heating season is recommended. Also, the current ventilation system does not provide adequate ventilation to the basement offices currently occupied. The recommendation is made that the current system be removed and a new building-wide HVAC system be installed. The cost for the new HVAC system is estimated to be $65K for service to all areas of the building.

2.10 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN ENID, OKLAHOMA

The main post office in Enid, Oklahoma, located at 115 West Broadway, is a three-story building constructed in 1940. The substructure consists of a one-level basement subdivided with concrete and hollow-clay tile walls. The approximately 85,000-ft^2 building has two HVAC forced-air systems. Heating is provided by hot water exchange, while cooling is provided by chilled water. The fresh air intakes are located on the roof of the building.

In 1989, GSA personnel performed radon testing at the site; one reading of 23.1 pCi/L was reported on the third floor. In August 1992, USPS personnel performed 50 short-term radon measurements (including the area identified by GSA). All of the measurements were <4 pCi/L.

In June 1994, radon mitigation diagnostics were performed by the HAZWRAP team. The mitigation diagnostics performed at the site are summarized in Table 40.

Table 40. Mitigation diagnostics summary for the U.S. Post Office in Enid, Oklahoma

Diagnostics test	Number of tests	Comments
Air change	9	
Blower door	Not completed	No suitable exterior door
Subslab	Part 1 completed Part 2 completed	
Continuous radon measurements	21 measurements	
Flow hood	Not completed	No access to vents
Radon entry pathway	11	1 to 23 counts per minute
Differential pressure	22	Basement and second floor: positive First floor: neutral

During the diagnostics, 21 continuous radon measurements were performed. All of the measurements were <4 pCi/L. No increase in radon concentration was observed during the night cycle of the HVAC system. The average data are listed in Table 41.

Table 41. Summary of continuous radon measurements for the U.S. Post Office in Enid, Oklahoma

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	0.2	Postmaster's office
02	0.8	Room 16
03	0.6	Room 30
04	0.4	Room 10
05	0.3	Room 5
06	0.6	Room 40
07	0.4	Room 17
08	1.7	Room 33
09	0.5	Main room
10	0.7	Room 11
11	0.5	Main room

Table 41 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
12	0.9	Room 41
13	0.5	Main room
14	1.4	Room 37
15	0.8	Room 13
16	0.8	Main room
17	0.5	Room 18
18	0.6	Room 32
19	0.7	Main room
20	0.8	Room 30
21	0.9	Postal supply room

Air change measurements were performed in various rooms in the building. The data indicate significant differences between night and day ACH rates as a function of the HVAC cycle. The data are summarized in Table 42.

Table 42. Air change summary for the U.S. Post Office in Enid, Oklahoma

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Basement 11	101/4855	0.17	Air conditioning off
Main room	1A/9346	0.28	Air conditioning off
209	1A/2377	0.33	Air conditioning off
Basement 11	101/4855	0.84 0.14	Air conditioning on Air conditioning off
Main room	1A/9346	0.32	Air conditioning on
209	1A/2377	0.30	Air conditioning on
Basement 30	101/4855	0.21	Air conditioning off
Supervisor's office	1A/9346	0.31	Air conditioning on
217	1A/2377	0.39	Air conditioning on

Subslab diagnostics were performed in the boiler room in the basement. The data indicate excellent field extension beneath the slab (Table 43).

Table 43. Subslab field extension data for the U.S. Post Office in Enid, Oklahoma

Hole 1.45 (in.)	Location	Field extension (ft)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Boiler room	45 (+)	7.5	Cinder settled 0.1 to 2 in.	11 in.

Radon entry pathway diagnostics were performed in various areas in the basement. None of the measurements identified any significant entry pathways. Table 44 lists the data.

Table 44. Radon entry pathway diagnostics for the U.S. Post Office in Enid, Oklahoma

Hole type	Location	Counts per minute
Electrical outlet	Room 13	0
Electrical outlet	Room 17-19	3
Electrical outlet	Room 28	1
Sump	Room 36	10
Drain	Room 36	7
Drain	Room 41	23
Electrical outlet	Room 30	4
Electrical outlet	Room 29	5
Drain	Room 29	3
Drain	Room 10	4
Elevator	Elevator pit	1

DP measurements were performed in various rooms throughout the building. The building appears to be pressurized relative to the outdoors. Table 45 lists the DP data by room.

Table 45. Differential pressure measurements for the U.S. Post Office in Enid, Oklahoma

Location	Differential pressure relative to outdoors (Pa)
Basement	**Basement**
Hallway	3
7	3
10	2
16	7
17	7
18	7
28	6
29	3
40	3
First Floor	**First Floor**
Lobby	3
Main room	3
Back entry	2
Stairwell	7
Second Floor	**Second Floor**
Hallway	7
209	7
217	7
219	7
223	7

Two mitigation diagnostics could not be performed because of building design problems. The blower door tests could not be performed because a suitable exterior door was not available. The flow hood tests could not be performed because of the vent style.

Based on the data generated, no radon mitigation is required for this building. However, if a radon problem occurs, the HVAC system should be rebalanced to the parameters listed in Table 45.

2.11 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN FLORISSANT, MISSOURI

The main post office in Florissant, Missouri, is a leased, two-story, slab-on-grade building. The approximately 55,000-ft^2 building has multiple HVAC forced-air systems. Heating is provided by a hot water exchanger, while cooling is provided by air compression. The fresh air intakes are located on the roof of the building, and the system cycles down during nonpeak hours.

During 1992–1993, USPS personnel performed 70 1-year radon measurements. Three readings were found to be >4 pCi/L. Subsequent follow-up measurements failed to confirm the elevated readings. However, the building conditions during the confirmation measurements were in question.

In June 1994, the HAZWRAP radon mitigation diagnostics team conducted mitigation diagnostics at the site. The mitigation data are summarized in Table 46.

Table 46. Radon mitigation diagnostics summary for the U.S. Post Office in Florissant, Missouri

Diagnostics test	Number of tests	Comments
Air change	4	Poor
Blower door	Not completed	No suitable exterior doorway
Subslab	Not completed	Underground utilities, no building plans
Continuous radon measurements	21 measurements	No elevated radon
Flow hood	Not completed	Could not reach supply ducts
Radon entry pathway	6	2 to 12 counts per minute
Differential pressure	32	15 positive and 17 negative measurements

During the mitigation diagnostics, 21 continuous radon measurements were performed. All of the average readings were <1 pCi/L. No increase in radon concentration was observed as a function of the HVAC cycle. Since the last radon measurements performed by USPS, the HVAC system has been replaced. The average data are summarized in Table 47.

Table 47. Summary of continuous radon measurements for the U.S. Post Office in Florissant, Missouri

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	0.40	Customs office
02	0.6	Room 162
03	0.4	Postmaster's office

Table 47 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
04	0.4	Room 2224
05	0.5	Room 132
06	0.4	Room 156
07	0.3	Room 167
08	0.4	IRS office
09	0.7	IRS office
10	0.8	Main room
11	0.7	Room 2222-C
12	0.7	Main room
13	0.9	IRS office
14	0.8	Custom's office
15	0.8	Storage across from Room 2220R
16	0.9	Room 2224
17	0.7	Room 117
18	0.6	Main room
19	0.8	Main room
20	0.5	Room 2222
21	0.6	IRS office

Air change measurements were performed in various rooms in the building. The data indicate significant differences between night and day ACH rates as a result of the HVAC system being off and on (Table 48). Even with the HVAC system on, the ACH was found to be substandard.

Table 48. Air change summary for the U.S. Post Office in Florissant, Missouri

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Main room (front left)	1A/2377	0.23 0.05 0.14	Air conditioning on Air conditioning off Air conditioning on
Main room (back right)	101/4855	0.17 0.02	Air conditioning on Air conditioning off
Reception (front)	1A/9346	0.19 0.02 0.08	Air conditioning on Air conditioning off Air conditioning on
IRS office	1A/2377	0.28 0.08	Air conditioning on Air conditioning off

Radon entry pathway diagnostics failed to locate a major radon entry pathway at the site. The data are listed in Table 49.

Table 49. Radon entry pathway summary for the U.S. Post Office in Florissant, Missouri

Hole type	Location	Counts per minute
Drain	Hallway (GSA side)	8
Wall-to-floor joint	Boiler room	7
Floor joint	Room 132 storage	12
Drain	Air handler (Room 135)	4
Drain	Men's restroom (Room 153)	4
Drain	Breakroom	2

DP measurements were performed in various rooms at the site. The data are listed in Table 50.

Table 50. Differential pressure measurements for the U.S. Post Office in Florissant, Missouri

Location	Differential pressure relative to outdoors (Pa)
First Floor	First Floor
Entry	0
Breakroom	-3

Table 50 (continued)

Location	Differential pressure relative to outdoors (Pa)
Door 150	-2
Hall	2
Men's locker room	5
Men's restroom	1
Hall/office	5
Door 159	3
Door 702	4
Assistant Postmaster's office	2
Lobby	1
Main room	1
General office	0
Postmaster's office	0
Door 156	-2
Door 145	14
Women's locker room	-1
Postal supplies	0
Repair shop	3
Storage	1
Hall/government office	3
Second Floor	**Second Floor**
Entry	-4
Hallway	-6
2218	-6
2222	-4
2223	-8
2224	-5

Table 50 (continued)

Location	Differential pressure relative to outdoors (Pa)
2225	-6
2226	-6
2220 Customs	-4

Mitigation diagnostics could not be performed on the blower door (for lack of a suitable door) and the flow hood (because of the height of the supply vents); subslab tests could not be performed because of the lack of building plans and the presence of underground utilities.

Because the new HVAC system has apparently mitigated the radon problem, no further mitigation action is needed. However, because of the poor indoor air quality and ventilation rates, it is recommended that the amount of fresh air into the building be increased by 50%.

2.12 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN GRIFFIN, GEORGIA

The main post office in Griffin, Georgia, is a two-level, daylight basement building constructed approximately 21 years ago. The approximately 20,000-ft^2 building has four HVAC forced-air systems. Heating is provided by a hot water exchanger, while cooling is provided by chilled water. The fresh air intakes are located on the roof of the building. Since its original construction, the basement office area has undergone numerous modifications in the GSA office area.

During 1992–1993, USPS performed 43 1-year radon measurements. Eight radon measurements >4 pCi/L were found. Subsequent short-term follow-up readings failed to confirm the elevated 1-year measurements. However, information collected from the site (after the short-term measurements had been performed) indicated that HVAC supply duct modifications had occurred between the two radon measurements (Social Security and Department of Agriculture areas).

In April 1994, the HAZWRAP mitigation diagnostics team performed mitigation diagnostics at the site. The mitigation diagnostics data are summarized in Table 51.

Table 51. Radon mitigation diagnostics summary for the U.S. Post Office in Griffin, Georgia

Diagnostics test	Number of tests	Comments
Air change	10	
Blower door	1 measurement	Data inconclusive
Subslab	Part 1 completed Part 2 completed	Below average field extension
Continuous radon measurements	20 measurements	
Flow hood	23	Inconclusive

Table 51 (continued)

Diagnostics test	Number of tests	Comments
Radon entry pathway	14	26 to 360 counts per minute
Differential pressure	47	

During the mitigation diagnostic measurements, 20 continuous radon measurements were performed (Table 52). Only one area, the boiler room tunnel, averaged above the action level. However, several rooms showed an increase in radon concentration as a function of the HVAC night cycle.

Table 52. Continuous radon measurements for the U.S. Post Office in Griffin, Georgia

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	1.2	Room G-27
02	5.0	Boiler room tunnel
03	1.7	Social Security back office
04	1.9	Room G-40
05	1.3	Room G-9
06	2.2	Boiler room
08	1.6	Social Security breakroom
09	0.5	Main room
10	1.3	Elevator room
12	1.6	Room G-27
13	1.8	Room G-11
14	0.7	Room 111
16	0.8	Maintenance office
17	1.7	Lawn mower room
18	0.4	Breakroom
19	0.8	Postmaster's office
20	1.8	Room G-20

Table 52 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
22	0.2	Main room
23	1.5	Computer room

Air change measurements were performed in various rooms in the building. The data indicate significant differences between night and day ACH rates as a function of the HVAC cycle (Table 53). During normal HVAC operation, the ACH rate is within proper specifications for an office environment.

The HVAC system at the site is the original system installed in the building (i.e., the system is 21 years old). However, the system is in better operating condition than any of the HVAC systems (including new ones) observed by the mitigation team during the 25 on-site USPS facility investigations.

Table 53. Air change summary for the U.S. Post Office in Griffin, Georgia

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Main room	1A/4855	0.67	Air conditioning on
Secondary sort room	101/2377	0.55	Air conditioning on
Main room	1A/4855	0.71 0.10	Air conditioning on Air conditioning off
Secondary sort room	101/2377	0.43 0.13	Air conditioning on Air conditioning off
G-9	1A/4855	0.92 0.35 0.02	Air conditioning on Air conditioning transition Air conditioning off
G-11	101/2377	0.53 0.23 0.06	Air conditioning on Air conditioning transition Air conditioning off
G-30	1A/9346	0.74 0.32 0.25	Air conditioning on Air conditioning transition Air conditioning off
G-9	1A/4855	0.93	Air conditioning on

Table 53 (continued)

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
G-11	101/2377	0.68	Air conditioning on
G-30	1A/9346	0.83	Air conditioning on

Subslab diagnostics performed in the basement indicate limited field extension beneath the slab. The data are summarized in Table 54.

Table 54. Subslab field extension data for the U.S. Post Office in Griffin, Georgia

Hole 1.50 (in.)	Location	Field extension (ft)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Mechanical equipment room	<10	5	0.5 gravel	9

Radon entry pathway diagnostic data indicated several potential entry pathways in the boiler room area. The recommendation was made to the site maintenance staff that the holes be sealed with a concrete patch or an elastomeric sealant. The data are listed in Table 55.

Table 55. Radon entry pathway diagnostic data for the U.S. Post Office in Griffin, Georgia

Hole type	Location	Counts per minute
Termite drill hole	Tunnel	37
Termite drill hole	Tunnel	225
Termite drill hole	Tunnel	183
Termite drill hole	Tunnel	40
Termite drill hole	Tunnel	42
Termite drill hole	Tunnel	145
Termite drill hole	Tunnel	53
Wall-to-floor joint	Mechanical room next to pumps	360
Termite drill hole	Mechanical room next to pumps	260
Termite drill hole	Mechanical room next to pumps	65
Floor drain	Water heater in mechanical room	55

Table 55 (continued)

Hole type	Location	Counts per minute
Termite drill hole	Mechanical room near outside entrance	305
Electrical outlet	Room G-20	30
Electrical outlet	Room G-20	26

The HVAC system at the site is both an autosensing and autoadjusting forced-air system. Hence, if a sensor in one of the four HVAC zones indicates too little or too much demand, the system automatically adjusts the air flow into the zone to compensate for the imbalance. This, in turn, increases the air flow demand on the other three zones. Consequently, the flow hood measurements performed in the building would be episodic to a particular condition. The data listed are listed in Table 56.

Table 56. Flow hood measurement summary for the U.S. Post Office in Griffin, Georgia

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Hallway outside of room G-35	61	78
Room G-32	32	37
Room G-28	146	146
Room G-28	130	128
Room G-24	82	82
Room G-24	128	131
Lobby to GSA side	127	154
Lobby to GSA side	127	133
Lobby to GSA side	128	221
Lobby to GSA side	107	136
Room 118	54	78
Room 116	100	150
Room 115	49	131
Men's restroom by G-18	35	36
Room G-17	39	54

Table 56 (continued)

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Room G-17	39	39
Room G-17	43	43
Room G-13	37	40
Room G-13	39	46
Room G-12	100	117
Room G-9	57	62
Room G-9	123	261
Room G-7	73	166

DP measurements were performed in 47 rooms at the site. The data are listed in Table 57.

Table 57. Differential pressure measurements for the U.S. Post Office in Griffin, Georgia

Location	Differential pressure relative to outdoors (Pa)
First Floor	First Floor
Lobby	1
G-7	5
G-4	0
Hallway	2
G-10	3
G-17	4
G-12-13	7
G-14	4
616-27	3
G-18	3
G-19	2
G-20	4
G-21	3

Table 57 (continued)

Location	Differential pressure relative to outdoors (Pa)
G-24	3
G-25	5
G-35	-5
G-34	-3
G-33	-8
G-28	4
G-32	1
G-31	2
Rear entry	6
Main room	7
129 (shop)	7
124	4
121	4
120	4
119	5
Main lobby	5
Envelope storage	7
Postal records	8
Elevator lobby	4
135 Men's restroom	4
135 Women's restroom	6
Stairway	3
Stairway	6
117	0
116	2
115	1

Table 57 (continued)

Location	Differential pressure relative to outdoors (Pa)
112	3
111	0
Counter lobby	1

During the entry pathway diagnostics, numerous chlordane (termitcide) insertion holes (3/8 in.) were observed in the boiler tunnel. The data (Table 55) indicate a strong possibility that the holes were an entry pathway. The recommendation was made to the site that the holes be sealed and the building retested for radon. In May 1994, radon detectors were placed by USPS personnel for 90-day measurements but no improvement was observed.

Because the building has a cyclic HVAC system, it was theorized that the elevated radon might be limited solely to nonduty cycle hours. To test the theory, three Femto-Tech Model F-210 detectors were placed in the computer room, Rooms G13 and G30 (boiler room) for 27 continuous days (September–October 1994). The data, shown in Figs. 7, 8, and 9, show a strong correlation to the HVAC night cycle and an increase in radon concentration. A good example is Fig. 10, which shows that for a 10-day period, the radon begins increasing between 5 and 7 p.m., peaks between 12 p.m. and 3 a.m., and returns to low levels (e.g., <4 pCi/L) between 4 and 7 a.m.

Because the building has multiple, automatic, on-demand fresh air dampers, the blower door test was inconclusive. Within 1 minute of depressurizing the building, the automatic fresh air dampers would sense the pressure imbalance, engage, and override the blower door fan. To disable the system would have potentially taken several hours and might have resulted in permanent HVAC system damage. Therefore, it was elected not to complete the diagnostic test.

A closer examination of the radon data reveals that the only location within the building with consistent elevated radon levels is the boiler room tunnel. The need for mitigation in this area is in question because the area is an unoccupied crawl space. If mitigation is deemed necessary, then adequate reduction could be attained with the installation of a single 500-ft^3/min HRV at the south end of the tunnel. To ensure good sweeping action, the HRV supply duct should exhaust near the middle of the tunnel. The estimated mitigation cost for the boiler room tunnel would be $4K.

With respect to the radon problem in occupied areas, it appears to only be a problem during the nonworking hours. The most cost-effective mitigation would be the implementation of the following radon management plan:

Radon Management Plan for the U.S. Post Office in Griffin, Georgia

1. Inform all tenants about the hazards of radon.

2. Describe the operation of the HVAC system and its impact on the radon concentration.

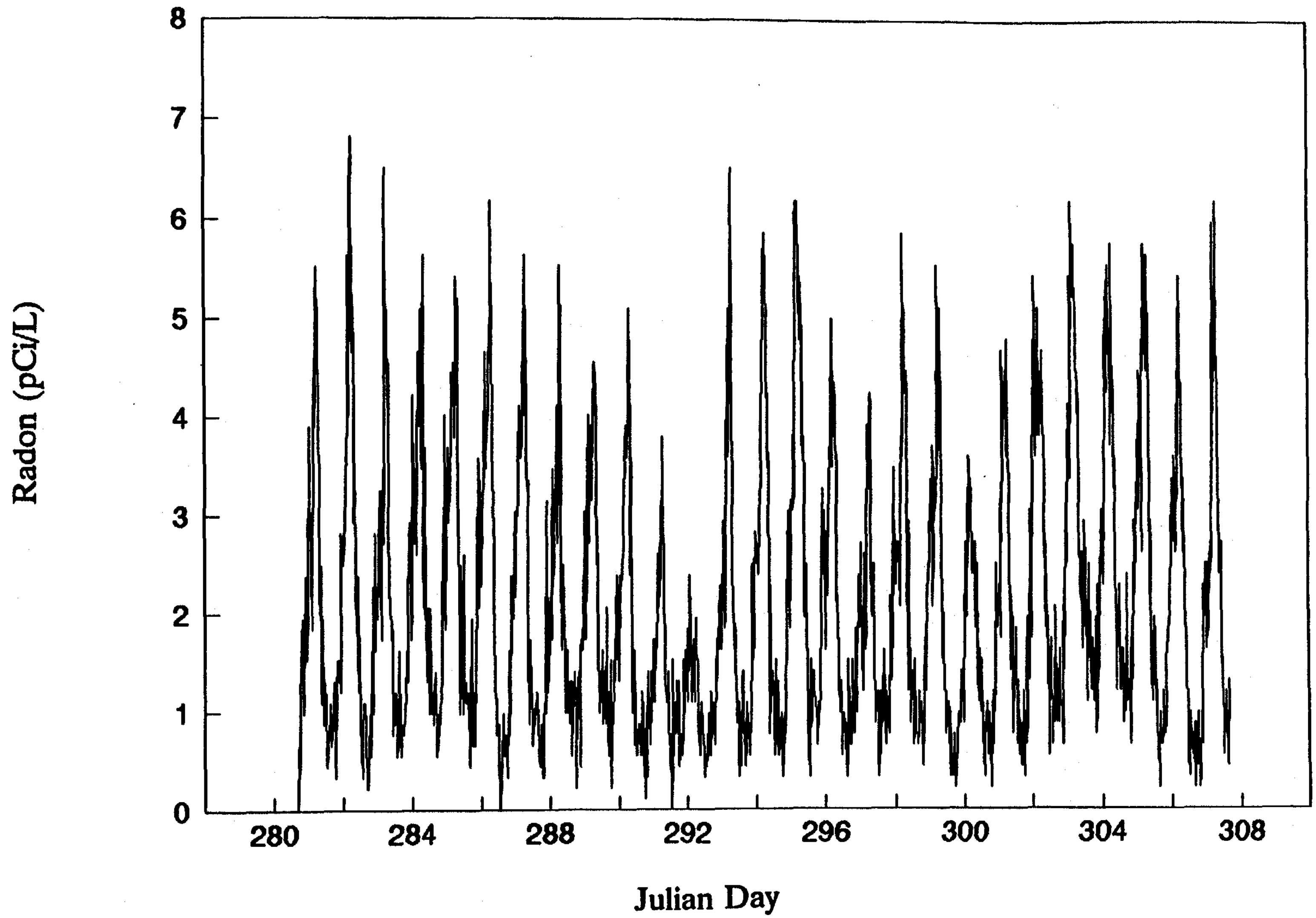


Fig. 7. Radon levels in the computer room at the U.S. Post Office in Griffin, Georgia.

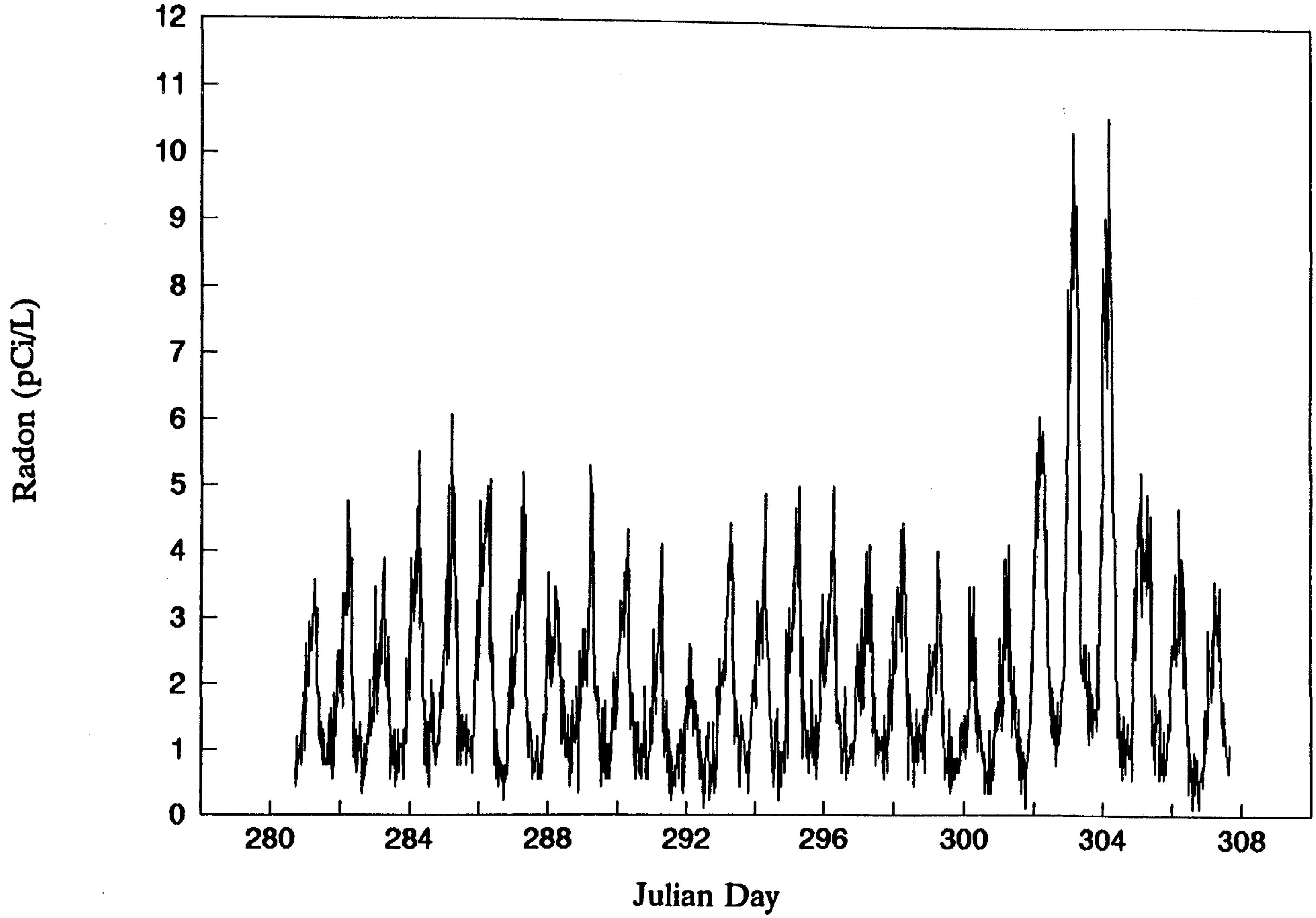


Fig. 8. Radon levels in Room G-13 at the U.S. Post Office in Griffin, Georgia.

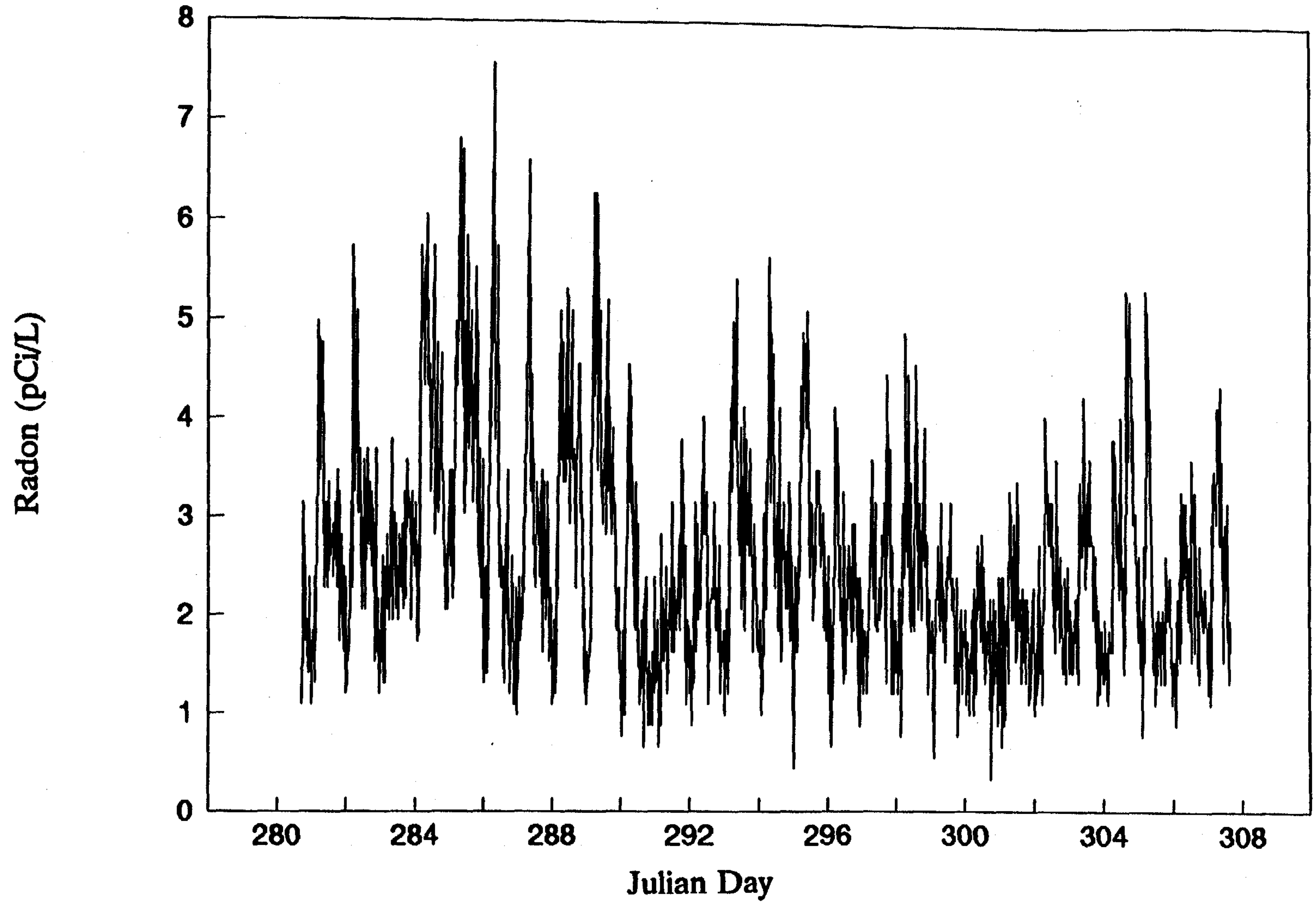


Fig. 9. Radon levels in Room G-30 at the U.S. Post Office in Griffin, Georgia.

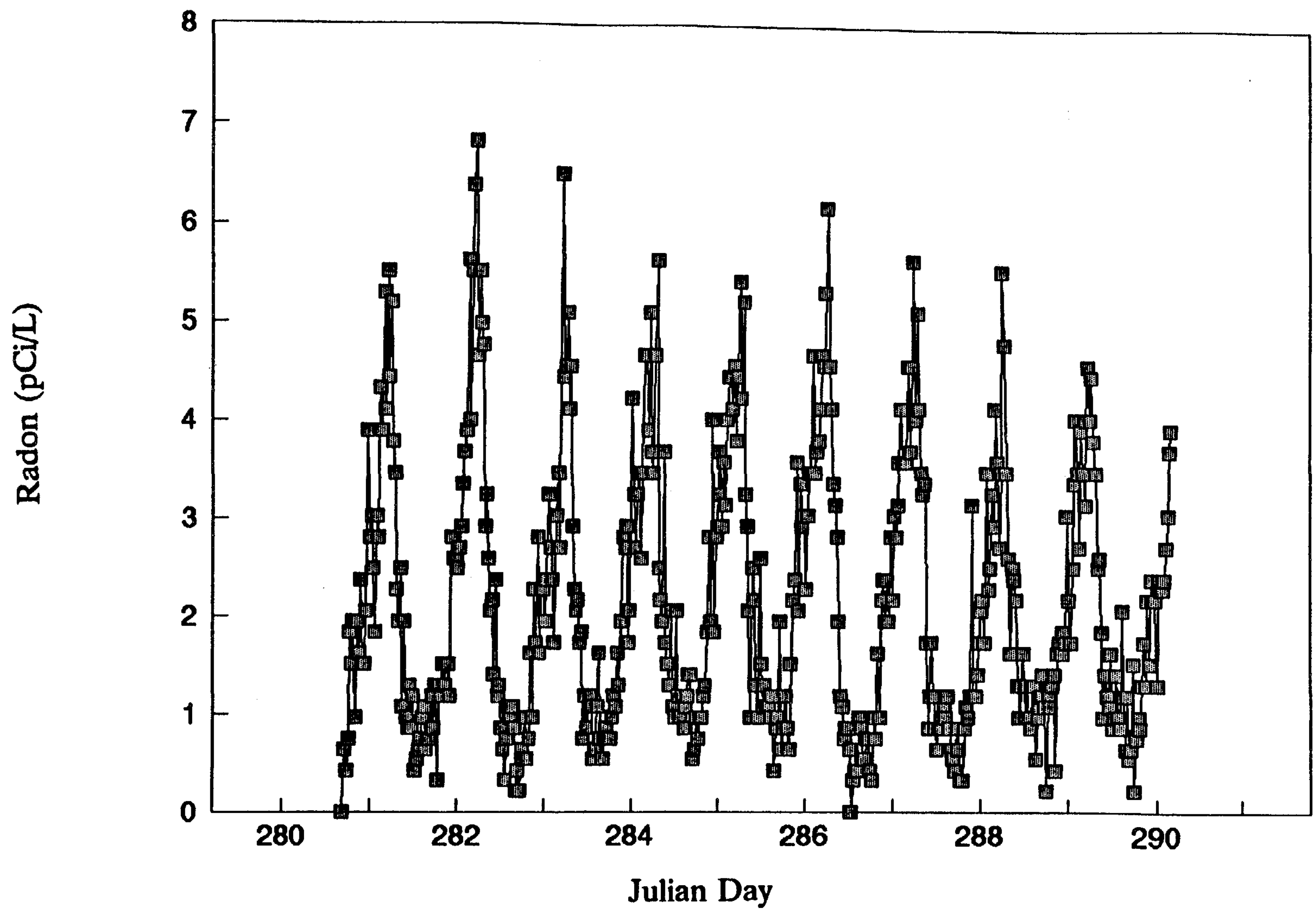


Fig. 10. Cyclic radon levels in the computer room at the U.S. Post Office in Griffin, Georgia.

3. Require all tenants to inform the building maintenance supervisor if they are planning to perform work in the basement from 9 p.m. to 4 a.m. so that the HVAC system may be left in full operation during that time.

If a management plan is unacceptable, then the blower of the HVAC system should be left in continuous operation with the air-exchangers taken off-line. This would allow for continued ventilation of the area while not increasing the energy consumption. If implemented, caution should be used during the heating season to avoid freezing of the unheated exchanger.

2.13 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN LANCASTER, OHIO

The main post office in Lancaster, Ohio, is a two-story building originally constructed in 1910 with additions in 1934 and 1964. The substructure consists of a one-level basement subdivided with hollow clay tile and concrete walls. The approximately 22,500-ft^2 building has multiple HVAC forced-air systems. Heating is provided by a hot water exchanger, while cooling is provided by chilled water. The fresh air intakes are located on the roof.

During 1992–1993, 35 1-year radon measurements were performed. All of the measurements were >4 pCi/L. Due to the high frequency of elevated readings, no confirmation tests were performed.

In July 1994, the HAZWRAP radon mitigation diagnostic team performed mitigation diagnostics at the site. The diagnostics performed are summarized in Table 58.

Table 58. Radon mitigation diagnostics summary for the U.S. Post Office in Lancaster, Ohio

Diagnostics test	Number of tests	Comments
Air changer	4	
Blower door	2	Inconclusive due to building size
Subslab	Part 1 completed Part 2 completed	
Continuous radon measurements	21 measurements	
Flow hood	21	
Radon entry pathway	8	0 to 8 counts per minute
Differential pressure	32	

During the mitigation diagnostics, 21 continuous radon measurements were performed. Five average measurements were found to be >4 pCi/L. During the night, only the normal diurnal increase in radon was observed. The continuous radon data are summarized in Table 59.

Table 59. Summary of continuous radon measurements for the U.S. Post Office in Lancaster, Ohio

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	3.5	Workshop
02	2.4	Chiller room
03	4.0	Room 41
04	1.6	Main room (back left)
05	1.6	Main room (front right)
06	2.7	Room M-108
07	1.3	Conference room
08	4.0	Room 43
09	2.6	Room M-110
10	2.8	Room M-112
11	1.8	Computer area
12	1.4	Main room (back right)
13	1.0	Room M-101
14	4.6	Room B-11
15	1.2	Main room (front left)
16	4.2	Room 36
17	2.2	Room 5
19	4.2	Room 20
20	3.7	Room 55
21	3.5	Room 31

The ACH measurements performed at the site were complicated by the seasonal operation of the HVAC system. For example, three HVAC systems operate 24 hours/day during the cooling season vs 3/4 of the day during heating season. Also, the percentage of fresh air is adjusted in the winter to bring in a higher percentage than in the summer (static electricity control). Based on this information, it is assumed that the ACH rates listed in Table 60 would be higher during the winter months. Because the measurement was taken in July, the air handler was on continuously and the team was unable to obtain an HVAC-off measurement. The ACH data are summarized in Table 60.

Table 60. Air change measurement summary for the U.S. Post Office in Lancaster, Ohio

Room number	Instrument number	Air change (hour^{-1})	Comments
Postmaster's office	1A/4855	0.35	Air conditioning on
Main room (front)	1A/2377	0.42	Air conditioning on
Main room (rear)	101/9346	0.31	Air conditioning on
Postmaster's office	1A/4855	0.31	Air conditioning on
Main room (front)	1A/2377	0.40	Air conditioning on
Main room (back)	101/9346	0.30	Air conditioning on
55	1A/4855	0.48	Air conditioning on
36	1A/2377	0.51	Air conditioning on
Shop	101/9346	0.31	Air conditioning on
55	1A/4855	0.44	Air conditioning on
36	1A/2377	0.43	Air conditioning on
Shop	101/9346	0.30	Air conditioning on

Subslab mitigation diagnostics were performed in the basement. The results, listed in Table 61, indicate marginal field extension beneath the slab.

Table 61. Subslab field extension data for the U.S. Post Office in Lancaster, Ohio

Hole 1.45 (in.)	Location	Field extension (ft.)	Slab thickness (in.)	Type subslab material	Subslab fill depth (in.)
1	Boiler room	10	5	Compacted earth	0

Radon entry pathway diagnostics failed to locate a significant entry pathway into the building. The data are listed in Table 62.

Table 62. Radon entry pathway diagnostic data for the U.S. Post Office in Lancaster, Ohio

Hole type	Location	Counts per minute
Drain	Boiler room	6
Water pipe in wall	Supply room	4
Electrical outlet	Supply room	7
Wall	Supply room	4
Drain	Conference room restroom	0
Drain	Chiller room	3
Electrical outlet	Room 43	8
Electrical outlet	Room 41	6

The DP data for the site indicate that the HVAC system is exhausting more air than is being incorporated and that the system is unbalanced. The DP data for various rooms are listed in Table 63, and the flowhood measurements are listed in Table 64.

Table 63. Differential pressure measurements for the U.S. Post Office in Lancaster, Ohio

Location	Differential pressure relative to outdoors (Pa)
Basement	**Basement**
Entry	-4
Hallway	-1
55	7
Next to 55	-4
29	-1
45	2
44	-2
25	-2
43	1
41	3
40	0
Post Office lobby	-2

Table 63 (continued)

Location	Differential pressure relative to outdoors (Pa)
Box lobby	1
Main room	-1
Women's restroom	-7
Men's restroom	-6
Mechanical room	-17
Work shop	-15
B-3	-14
B-4	-9
Next to 40	1
36	1
B-29	-1
B-30	0
B-28	-1
B-18	1
B-17	2
20	2
B-10	-8

Table 64. Flow hood measurements for the U.S. Post Office in Lancaster, Ohio

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Room 55 (front)	245	254
Room 55 (middle)	228	234
Room 55 (middle)	263	270
Room 55 (middle)	246	255
Room 55 (back room)	147	152

Table 64 (continued)

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Room 55 (side room, front)	119	133
Room 55 (side room, middle)	109	112
Room 55 (side room, back)	99	99
Room 43 (front)	63	74
Room 43 (front)	98	101
Room 43 (side room)	76	91
Room 43 (side room)	49	49
Room 43 (back room)	295	300
Room 41 (front)	105	122
Room 41 (back)	76	79
Room 20 (front)	121	125
Room 20 (middle)	109	118
Room 20 (back)	116	119
Room 20-B	91	99
Room 17 (front)	136	136
Room 17 (back)	125	133

Although the blower door measurements were performed, the data were found to be inconclusive due to the building size and the power of the HVAC blower.

Based on the DP data (Table 63), it appears that the system is unbalanced and is exhausting more air than it is taking in. Generally, for a large building, 5 to 10% more fresh air should be imported than is being exhausted. However, this appears not to be the case for the building. The first mitigation step should be a complete inspection of the HVAC system by an ASHRAE-certified HVAC technician. A cost-benefit study of repairing the existing system vs replacing the system with a newer system should be performed. During the inspection, particular attention should be paid to the fresh air intakes and indoor exhaust and the forced-air system balance. The amount of fresh air should be increased to 5 to 10% more than the amount exhausted. If this is not possible, then a 5 to 10% reduction in flow exhaust should be performed. After these adjustments are made, two sets of radon measurements should be performed (heating and cooling season measurements). The estimated cost for inspection, adjustment, and replacement-benefit analysis of the existing HVAC system is $4K.

2.14 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN LOWVILLE, NEW YORK

The main post office in Lowville, New York, is a two-story building constructed in 1939. The substructure consists of a one-level basement subdivided with concrete walls. The approximately 13,500-ft^2 building has no central HVAC or HAC forced-air systems. Heating is provided by a hot water exchanger, while cooling is provided two window air conditioning units.

During 1992–1993, 15 1-year radon measurements were performed. Five results were found to be >4 pCi/L. No confirmation data were collected.

In July 1994, the HAZWRAP mitigation diagnostic team performed radon mitigation diagnostics at the site. Table 65 summarizes the diagnostics performed.

Table 65. Radon mitigation diagnostics summary for the U.S. Post Office in Lowville, New York

Diagnostics test	Number of tests	Comments
Air change	3	
Blower door	Not completed	No suitable exterior doorway and open windows
Subslab	Attempted, not successful	High water table
Continuous radon measurements	17 measurements	Open windows
Flow hood	Not completed	No forced-air system
Radon entry pathway	7	11 to 95 counts per minute
Differential pressure	11	

During the mitigation diagnostics, continuous radon measurements were performed (Table 66). As expected, with the windows open, the radon levels were found to be consistently <4 pCi/L during the day. However, radon levels increased at night after the windows were closed. The radon levels in the basement were >4 pCi/L during both nights in the small room.

Table 66. Summary of continuous radon measurements for the U.S. Post Office in Lowville, New York

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	1.1	Records storage room
02	0.3	Main room (front right)
04	0.5	Main room (back left)
06	1.8	Old Army recruiting office

Table 66 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
07	1.3	Supply room
10	1.8	Room next to old Army room
11	1.1	Storage off boiler room
12	0.6	Main room (back right)
13	1.1	Boiler room
14	0.5	Main room (front left)
15	1.6	Small storage room (basement)
16	1.5	Basement hallway
17	0.7	Maintenance shop
19	0.2	Postmaster's office
20	2.5	Small room in basement
21	0.1	Second floor

Air change measurements were performed in various rooms and floors in the building. As predicted, the ACH rate during the day (with windows open) was significantly higher than the night ACH rate under closed building conditions. The ACH data are summarized in Table 67.

Table 67. Air change summary for the U.S. Post Office in Lowville, New York

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Postmaster's office	1A/2377	1.35	Window air conditioning on, door open
Old recruiting office	101/9346	0.50	No air conditioning system (day)
Main room	1A/4855	0.09	No air conditioning system (night)
Old recruiting office	101/9346	0.03	No air conditioning system (night)
Main room	1A/4855	0.04 0.46	Doors closed (night) Doors open (day)
Postmaster's office	1A/2377	0.05 0.43	Doors closed (night) Doors open (day)

Radon entry pathway diagnostics identified two marginal radon entry points in the basement boiler room (sump and wall hole). No other significant pathways were identified. The data are listed in Table 68.

Table 68. Radon entry pathway diagnostics at the U.S. Post Office in Lowville, New York

Hole type	Location	Counts per minute
Drain	Boiler room sump	95
Wall	Boiler room	35
Wall	Large basement room	16
Drain	Large basement room	15
Electrical outlet	Large basement room	11
Electrical outlet	Supply room	13
Drain in wall	Water fountain in hall	13

Because this is not a forced-air system building, under exterior dead-air conditions, the DP measurements should vary between -3 and +3 Pa. However, during the testing, a slight breeze was noted from the Northwest; therefore, some variation would be expected. The data are listed in Table 69.

Table 69. Differential pressure measurements for the U.S. Post Office in Lowville, New York

Location	Differential pressure relative to outdoors (Pa)
Basement	**Basement**
Back entry	3
Main room	4
Women's restroom	3
Postmaster's office (air conditioning on)	4
Men's restroom	2
Lobby	3
Upstairs breakroom	2
Men's upstairs restroom	0
Downstairs back hall	0
Front hall	0

Due to problems at the site, three mitigation diagnostics could not be performed. The blower door could not be performed due the absence of a suitable exterior door and the presence of open windows. The flow hood measurement could not be taken because the building lacked a forced-air system. Subslab tests were not completed due to the presence of a high water table beneath the slab. After drilling the hole and applying suction, water (copious amounts) was observed being pulled from under the slab. Water continued flowing from the hole for several minutes after suction had been discontinued. Inspection inside the hole after the flow had subsided indicated that there was no damage to the subslab utilities pipe. The team elected to discontinue the diagnostic and seal the hole. Later, discussions with the maintenance staff confirmed that the pipe had not been damaged, but the team had found the natural water table (the Post Office is located directly over a swamp).

A major concern at the site is the condition of the existing ventilation. During the summer months, ventilation provided by open windows is more than adequate. However, if one equates summer night conditions with winter conditions (e.g., closed doors and windows), then the ACH during the winter months would be considerably substandard (see night ACH rates in Table 67). Consequently, if the ACH is a factor of ten lower during the winter, a similar increase in the radon levels would be expected.

The current mechanical conditions in the building are as follows. The building has no active means of ventilation. Opening windows is the only means of increasing the ventilation rate. Active cooling is limited to two small window air conditioning units; one in the postmaster's office and one in the main sort room. However, two large cooling units are present in the main sort room, but they not operational.

Based on the diagnostic data, only one mitigation solution, ventilation, is viable; however two options are available. Option 1 is the installation of 500-ft^3/min HRV units in the basement (one per quarter basement area). From the units, duct work would have to be run to all rooms in the basement to allow for a good sweeping action. Option 2 is the installation of an energy-efficient, natural gas powered HVAC forced-air system. In both cases, the minimal basement ventilation rate should be maintained at 0.5 ACH.

From a cost standpoint, the HRV solution is more attractive: \$20K vs \$85K. However, one major consideration, the long-term usage of the building, enters into the mitigation equation. In other parts of the country, buildings of this vintage, size, and type are being replaced because of the excessive cost of upgrading the buildings to grant the physically challenged access to services offered on the lower floor. If a building is going to be replaced within the next 8 to 10 years, then the HRV solution is the most attractive. However, if no long-term plans exist to replace the facility, then the installation of the HVAC forced-air system is the best long-term solution.

2.15 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN MACHIAS, MAINE

The main post office in Machias, Maine, is a two-story building with a slab-on-grade substructure constructed in 1967. The approximately 15,000-ft^2 building has five HVAC forced-air systems, four which are in a state of disrepair. Heating is provided by a hot water exchanger, while cooling is provided by compressor. The fresh air intakes are located on the roof of the building.

During 1992–1993, 14 1-year radon measurements were performed by USPS personnel. Eight readings were found to be >4 pCi/L. The diagnostics performed are summarized in Table 70.

Table 70. Mitigation diagnostics summary for the U.S. Post Office in Machias, Maine

Diagnostic test	Number of tests	Comments
Air change	3	
Blower door	Not completed	No suitable exterior doorway
Subslab	Not completed	48-in.-thick slab, subslab utilities and no building plans
Continuous radon measurements	20 measurements	
Flow hood	Not completed	HVAC units broken and vents not accessible
Radon entry pathway	3 completed	Very few areas accessible
Differential pressure	24	

During the mitigation diagnostics, 20 continuous radon measurements were performed. The data are listed in Table 71.

Table 71. Summary of continuous radon measurements for the U.S. Post Office in Machias, Maine

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	3.9	Breakroom
02	0.9	Room 118
04	1.8	Main room (back right)
05	1.7	Main room (front right)
06	4.6	Maintenance shop
07	1.1	Room 119
08	3.2	Men's restroom off breakroom
09	1.5	Main room (front left)
11	1.3	Room 209
12	1.4	Room 212
13	1.1	Room 109
14	0.7	Room 205

Table 71 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
15	0.9	Soil Conservation Office
16	2.5	Women's restroom off breakroom
17	1.0	Boiler room
18	0.5	Postmaster's office
19	0.7	Room 110
20	0.8	Computer room (GSA side)
21	1.3	Room 118-A

Air change measurements were performed in various rooms and floors of the building. The data indicate significant differences between HVAC on and off cycles. The ACH data are summarized in Table 72.

Table 72. Air change summary for the U.S. Post Office in Machias, Maine

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Main room	1A/9346	0.07	Air conditioning broken
118	1A/2377	0.66	Air conditioning on
109	101/4855	0.41	Air conditioning off
205	1A/9346	0.27	Air conditioning on
118	1A/2377	0.60	Air conditioning on
109	101/4855	0.33	Air conditioning on

Because most of the building was finished (e.g., tile or carpeted floor, finished walls, etc.), accessibility to logical entry pathways was limited. Of the three sites that were accessible, no major entry pathways were identified. The sites that were accessible and their results are listed in Table 73.

Table 73. Radon entry pathway diagnostics data for the U.S. Post Office in Machias, Maine

Hole type	Location	Counts per minute
Drain	Boiler room	4
Pipe from ground	Boiler room	10
Oil line hole	Boiler room	11

DP mapping was performed in various rooms within the building. The data are listed in Table 74.

Table 74. Differential pressure measurements for the U.S. Post Office in Machias, Maine

Location	Differential pressure relative to outdoors (Pa)
Basement	Basement
Entry	-5
Lobby/stairway	-4
Hallway	-3
110	-4
109	-3
118	-4
119	-4
Storage room	-2
Men's restroom	-1
Women's restroom	-2
Storage closet	-1
Upstairs entry	3
Upstairs hallway	-2
Soil office	0
205	2
207	12
209	17
Storage room	-9
Men's restroom	-6
Women's restroom	-3
212	-3
206	-3

Three diagnostic measurements could not be completed: the blower door (for lack of a suitable exterior door), flow hood (inaccessible supply vents and nonfunctional HVAC units) and the subslab diagnostics [due to the reported thickness of the slab (48 in.) and the absence of building plans].

The style, condition, and vintage of this post office is identical to the U.S. Post Office in Waynesville, North Carolina (Sect. 2.24). In addition to the physical characteristics, the ventilation characteristics are similar as well. At the Waynesville site, mitigation was accomplished by replacing the nonoperational HAC forced-air system with a fresh air intake HAC forced-air system. Based on the success at that site, the recommendation is made that a similar system be installed at this particular site. According to USPS sources, the final cost for installation of the Waynesville system was $59K. Therefore, the estimated mitigation cost for the U.S. Post Office in Machias would be the same.

2.16 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN MARION, INDIANA

The main post office in Marion, Indiana, is a two-story building originally constructed in 1941. Additions to the building were made in 1955 and 1965. The substructure consists of a one-level basement subdivided with poured concrete, hollow clay tile, and hollow cement block walls. The approximately 63,000-ft^2 building has multiple HVAC forced-air systems. Heating is provided by a hot water exchanger, while cooling is provided by chilled water.

During 1992–1993, 38 1-year radon measurements were performed by USPS personnel. Eleven results were >4 pCi/L.

In April 1994, the HAZWRAP radon mitigation diagnostic team performed radon mitigation diagnostics at the site. The mitigation diagnostics are summarized in Table 75.

Table 75. Radon mitigation diagnostics summary for the U.S. Post Office in Marion, Indiana

Diagnostics test	Number of tests	Comments
Air change	9	
Blower door	Completed	
Subslab	Part 1 completed Part 2 completed	
Continuous radon measurements	17 measurements	
Flow hood	Not completed	Vents inaccessible or wrong shape
Radon entry pathway	11	3 to 257 counts per minute
Differential pressure	21	

As part of the mitigation diagnostics, 17 continuous radon measurements were taken. Nine measurements were found to be >4 pCi/L. The data are summarized in Table 76.

Table 76. Summary of continuous radon measurements for the U.S. Post Office in Marion, Indiana

Instrument number	48-hour average radon measurement (pCi/L)	Location
02	1.7	Men's restroom
03	7.6	Basement Room 16
04	2.7	Basement Room 15
05	2.1	Basement Room 13
06	12.4	Open storage area pole B-2
08	2.5	Room 8
09	4.9	Room 23
10	5.9	Basement ducting area near Door 16
12	2.0	Room 3
14	2.3	Records Room 12
15	2.3	Room 25
17	1.6	Basement near Door 11
18	5.9	Basement by Door 9
19	7.1	Room 21
20	7.3	Room 22
22	13.8	Room 18
23	13.2	Room 16

Air change measurements were performed in various rooms and floors in the building. The team was unable to collect a stable ACH measurement during the HVAC day cycle; the suspected reason is transport of tracer gas from other zones. In the GSA office area of the basement, there was not an operational HVAC system; therefore the ACH measurements were not affected. The ACH measurements are reported in Table 79.

Table 77. Air change summary for the U.S. Post Office in Marion, Indiana

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
10-A	1A/9086	0.59	Blower on
3	101/4855	0.66 0.27	HVAC on HVAC off

Table 77 (continued)

Room number	Instrument number	Air change (hour^{-1})	Comments
14	1A/2377	0.11	HVAC off
3	101/4855	0.15	HVAC off
14	1A/2377	0.29	HVAC off
3	101/4855	0.08	HVAC off

Subslab diagnostics were performed in two basement rooms. The results (Table 78) indicate no communication beneath the slab.

Table 78. Subslab field extension data for the U.S. Post Office in Marion, Indiana

Hole 1.45 (inch)	Location	Field extension (ft)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Room 16	0	4	0.25 gravel	3
2	Boiler room	0	4.75	0.25 gravel	2

Radon entry pathway diagnostics indicate that the drain in Room 16 is a potential entry pathway for radon. All other measurements were insignificant. The data are listed in Table 79.

Table 79. Radon entry pathway data for the U.S. Post Office in Marion, Indiana

Hole type	Location	Counts per minute
Pipe	Large ducting room	3
Wall	Boiler room	4
Door jam	Boiler room	11
Drain	Room 8	4
Drain	Boiler room	5
Crack in wall	Room 16	46
Drain	Room 16	257
Wall	Room 14	52
Wall	Room 14	50
Pipe chase	Room 3	11
Man hole	Room 11	108

A blower door measurement was performed in the nonconditioned portion of the basement. Similar measurements performed in the conditioned areas were inconclusive. The blower door data are summarized in Table 80.

Table 80. Blower door data for the U.S. Post Office in Marion, Indiana

Location	Flow for 4 Pa (ft^3/min)	Leakage area ($in.^2$)	Room area (ft^2)	Ceiling height (ft)	Room volume (ft^3)
Basement	4,444	1,266	9,000 (estimate)	8	72,000

DP measurements were performed in various rooms in the basement. The data indicate that the basement is under negative pressure. The data are listed in Table 81.

Table 81. Differential pressure measurements for the U.S. Post Office in Marion, Indiana

Location	Differential pressure relative to outdoors (Pa)
Basement	**Basement**
16	-1
14	-2
11	-2
12	-4
13	-4
15	-4
Hallway	-4
10-A	-4
3	-4
R4-T	-4
7	-4
18	-4
Hallway	-7
21	-5
22	-7
Office	-5

Table 81 (continued)

Location	Differential pressure relative to outdoors (Pa)
Investment office	-5
Stairwell	-5
17	-5

The flow hood diagnostics measurement could not be performed because the forced-air system was not operational in the basement and the design of the vents was inconsistent with the flow hood templates.

Due to the poor subslab permeability, radon mitigation at this site is limited to only one solution, ventilation. A major factor in the mitigation recommendation for this site is the condition of the existing HVAC system. According to the site maintenance staff, the system is more than 20 years old and has never worked properly. For example, during the heating months, the air conditioning "make-up" air chiller must be removed from the intake hood or it will freeze. Also, none of the intake or outtake dampers work. Zonal mitigation using HRV units would potentially reduce the radon levels in the basement area. However, it would not solve the long-term mechanical problems in the building.

Estimating the cost for a new HVAC system for a building of this size is extremely difficult. For example, some of the supply duct in the basement was in need of replacement. It is suspected that a significant amount of the duct throughout the building is similar condition. In order for the proposed HVAC solution to work, the following features must be incorporated into the system:

1. An automatic pressure monitoring system must be installed in the basement to adjust fresh air intake and exhaust flow to maintain a constant pressure (3 Pa minimum).

2. Supply and return air ducting must be installed in all parts of the basement, and the system must be properly pressure balanced. Also, in each HVAC zone, the relationship for supply and return must be a piston-type flow to afford good area sweeping.

3. The basement area as a whole must receive 8,000 ft^3/min more in air supply than what is being exhausted.

4. The air turnover rate for the basement and all other areas of the building must be at least 0.5 ACH.

Another cost consideration is the heating fuel. For this part of Indiana, it is uncertain whether oil or natural gas is the least expensive fuel. Depending on options and features, a new HVAC system with the features described previously could cost between $200K to $350K.

2.17 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN PARIS, KENTUCKY

The main post office in Paris, Kentucky, built in 1965, is a two-story, slab-on-grade building. The approximately 13,500-ft^2 building has multiple forced-air system heat pumps located on the roof. Supplemental heating is provided by hot water at an exterior temperature below 38°F. There are no fresh air intakes for the building.

During 1992–1993, USPS personnel performed 25 1-year radon measurements. Twenty-one measurements were >4 pCi/L.

In March 1994, the HAZWRAP radon mitigation diagnostic team performed radon mitigation diagnostics at the site. The mitigation diagnostic data are summarized in Table 82.

Table 82. Radon mitigation diagnostics summary for the U.S. Post Office in Paris, Kentucky

Diagnostic test	Number of tests	Comments
Air change	12	
Blower door	Completed	GSA wing only
Subslab	Not completed	No building plans, asbestos floor tile, and subslab utilities
Continuous radon measurements	21 measurements	
Flow hood	Not completed	Grills inaccessible
Radon entry pathway	20	2 to 79 counts per minute
Differential pressure	18	

During the mitigation diagnostics, 21 continuous radon measurements were performed. Although all but one of the average measurements were <4 pCi/L, many of the time-interval measurements increased significantly above the action level during the night. The data are summarized in Table 83.

Table 83. Summary of continuous radon measurements for the U.S. Post Office in Paris, Kentucky

Instrument number	48-hour average radon measurement (pCi/L)	Location
03	1.0	Upstairs conference room
04	2.5	Men's bathroom
05	2.4	Main room (front right)
06	2.1	Main room (back right)

Table 83 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
08	4.2	Room 128
09	0.7	Room 201
10	1.0	Room 209 A-B
13	3.7	Women's bathroom
14	3.2	Room 124
15	2.8	Room 126
17	3.3	Main room (P.O. Box area)
18	3.0	Room 118
19	2.5	Main room corner
20	3.2	Postmaster's office
21	1.1	Main room (front center)
22	3.5	Room 121 (men's bathroom)
23	2.8	Room 105

Air change measurements were performed in various rooms in the building. The data are summarized in Table 85.

Table 85. Air change summary for the U.S. Post Office in Paris, Kentucky

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
128A	1A/4855	0.65	Winter heat on
Main room	1A/9346	0.47 0.12	Winter heat on Heater off
Breakroom	101/2377	0.32	Winter heat on

Radon entry pathway diagnostics failed to locate any significant entry pathways. The data are listed in Table 85.

Table 85. Radon entry pathway diagnostics for the U.S. Post Office in Paris Kentucky

Hole type	Location	Counts per minute
Wall	Breakroom	4
Wall crack	Breakroom	4
Background	Breakroom	8
Electrical outlet	Sort room	7
Drain	Room 105	13
Electrical outlet (floor)	Sort room	3
Wall-to-floor joint	Room 113	10
Pipe chase	Sort room by vault	3
Phone jack	Room 105	10
Wall crack	Room 105 closet	14
Floor joint	Box area (left wall)	18
Electrical outlet	Sort room (left wall)	79
Wall-to-floor joint	Loading dock (left side)	10
Heater unit	Hallway across from Room 129	16
Pipe chase	Room 123	8
Wall	Front lobby	17
Electrical outlet	Front lobby	12
Wall	Front lobby	12
Wall-to-floor joint	Room 124	9
Electrical outlet	Room 128-A	13

Blower door measurements were performed on the ground floor of the GSA wing. The data indicate that the GSA building is highly constructed. The data are listed in Table 86.

Table 86. Blower door data for the U.S. Post Office in Paris, Kentucky

Location	Flow for 4 Pa (ft^3/min)	Leakage area (in.^{2})	Room area (ft^2)	Ceiling height (ft)	Area volume (ft^3)
Office wing (ground floor)	733	207	3,700	8	29,600

DP measurements were performed in various rooms on the ground floor. The data indicate that the building is under significant negative pressure. Based on the blower door data (Table 86), the conclusion was that the building was tightly constructed. Therefore, the seemingly insignificant exhaust [such as bathroom fans (quantity 4), and leakage in the HAC blower box (located on roof)] would result in depressurization of the building. The data are listed in Table 87.

Table 87. Differential pressure measurements for the U.S. Post Office in Paris, Kentucky

Location	Differential pressure relative to outdoors (Pa)
Ground Floor	**Ground Floor**
Breakroom	-5
Men's restroom	-9
Service closet	-4
Women's restroom	-5
Loading dock	-5
Storage	-5
106	-6
Bathroom	-14 (suspect)
Lobby/counter	-5
Lobby door	-7
Front door	-9
Hole in wall	-8
Emergency door to outside	-4
Trash room	-4
Office	-5
Men's restroom	-5
Women's restroom	-4
Stairwell	-2

Two mitigation diagnostics could not be performed at the site. Subslab diagnostics could not be performed due to the presence of asbestos floor tile and subslab utilities and the absence of building plans. The flow hood test could not be performed due to the size and location of the forced-air system supply ducts.

The data in Table 87 indicated that the building was under negative pressure. Before active mitigation attempts are performed, it is strongly advised that all of the building mechanical systems be inspected (HAC and ventilation fans). The goal should be the attainment of neutral pressure throughout the building by means of mechanical balancing and incorporation of outside make-up air in the highly depressurized areas. If a neutral building can be attained, then retesting should be performed. The estimated cost for the passive attempt is $1K.

If the passive mitigation attempt fails, based on the mitigation diagnostic data collected, the best active mitigation method would be SP for this building. However, the selection of an exact means to accomplish this is another matter. According to the site maintenance staff, the existing HAC system is at least 20 years old. Due to its advanced age, units may have insufficient reserve capacity to both pressurize the building and maintain effective environmental control. If a qualified mechanical inspector finds sufficient life and capacity in the units, then the installation of one fresh air intake hood for each of the existing five roof HAC units on the roof would be the most cost-effective mitigation method. Assuming this is possible, the pressure of each room should be set to +5 Pa. The installation cost would be $4K.

However, if the units are too deteriorated or are scheduled for replacement within the next few years, then a modern HAC forced-air system equipped with fresh air intake hoods should be installed. Feedback pressure sensors should be installed in each room to ensure proper pressurization. As mentioned previously, each area should be pressurized to +5 Pa. The cost for complete mechanical replacement is estimated to be $59K.

2.18 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN RATON, NEW MEXICO

The main post office in Raton, New Mexico, is a 19,000-ft^2, two-story building constructed in 1966. The substructure is slab-on-grade. In June 1993, USPS personnel installed new, multiple HVAC, forced-air systems. Supplemental heating is provided by a hot water exchanger, while cooling is provided by gas. The fresh air intakes are located on the roof of the building.

In August 1992, USPS personnel performed 35 short-term radon measurements. None of the measurements were >4 pCi/L. However, previous radon data collected by GSA indicated elevated radon at the site.

In May 1994, the HAZWRAP radon mitigation diagnostic team performed radon mitigation diagnostics at the site. The diagnostic measurements performed at the site are summarized in Table 88.

Table 88. Radon mitigation diagnostics summary for the U.S. Post Office in Raton, New Mexico

Diagnostics test	Number of tests	Comments
Air change	6	
Blower door	1	Unsuccessful, too windy
Subslab	Part 1 completed Part 2 completed	Communication to outside
Continuous radon measurements	19 measurements	

Table 88 (continued)

Diagnostics test	Number of tests	Comments
Flow hood	Not completed	Incorrect vent sizes, and height
Radon entry pathway	15	5 to 185 Counts per minute
Differential pressure	34	Negative pressure

During the mitigation diagnostics, 19 continuous radon measurements were performed. Three areas were found to have radon in excess of the 4 pCi/L action level. The data are summarized in Table 89.

Table 89. Summary of continuous radon measurements for the U.S. Post Office in Raton, New Mexico

Instrument number	**48-hour average radon measurement (pCi/L)**	**Location**
01	1.1	Room 206
02	0.6	Main room (front center)
03	3.4	Room 114
05	0.8	Main room (center)
06	1.3	Room 205
08	3.7	Room 110
09	1.5	Room 211
10	1.0	Room 115
11	3.2	Conference room
12	4.6	Room 111
13	6.3	Room 109
14	4.7	Room 103
16	3.0	Room 105
17	0.7	Room 127
18	0.8	Main room (back right)
19	0.7	P.O. Box hallway

Table 89 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
20	0.6	Main room (back left)
22	1.0	Postmaster's office
23	0.9	Main room (left center)

Air change measurements were preformed in various rooms in the building. During the testing, the blower was on continuously. The most significant finding of the ACH measurements is that very little fresh air is being incorporated into the building. Nominal ACH rate for the rooms tested should be 0.5 ACH or greater. The data are summarized in Table 90.

Table 90. Air change summary for the U.S. Post Office in Raton, New Mexico

Room number	Instrument number	Air change (hour^{-1})	Comments
105	1A/2377	0.16	Air conditioning on
111	101/9346	0.10	Air conditioning on
105	1A/2377	0.16	Air conditioning on
Main room	1A/4855	0.23	Air conditioning on

Radon entry pathway diagnostics failed to locate any significant entry pathways. The data are summarized in Table 91.

Table 91. Radon entry pathway diagnostics for the U.S. Post Office in Raton, New Mexico

Hole type	Location	Counts per minute
Phone jack	Conference room	12
Phone jack	Room 103	31
Phone jack	Room 107	18
Phone jack	Room 109	29
Wall	Room 109	6
Phone jack	Room 111	17
Wall crack	Room 111	6

Table 91 (continued)

Hole type	Location	Counts per minute
Drain	Hallway GSA side	4
Wall-to-floor joint	Equipment room	65
Wall-to-floor joint	Equipment room	185
Wall-to-floor joint	Equipment room	86
Drain	Breakroom	12
Wall-to-floor joint	Main sort room	5
Phone jack	Assistant Postmaster's office	7
Phone jack	Postmaster's office	8

DP measurements indicated the building is slightly negative overall. The data are summarized in Table 92.

Table 92. Differential pressure measurements for the U.S. Post Office Raton, New Mexico

Location	Differential pressure relative to outdoors (Pa)
Back entry	-1
Main room	-1
Supply room	-1
Women's restroom	0
Swing room	0
Men's restroom	-1
Office next to Postmaster's office	-2
Postmaster's office	-2
Maintenance office	-1
Hallway	-4
115	0
111	-2
116	-4

Table 92 (continued)

Location	Differential pressure relative to outdoors (Pa)
109	-5
110	-3
Postal conference room	-4
105	-4
103	-4
Stairwell	-2
Main lobby	-2
Hallway	3
216-A	2
216	3
213	3
211	3
214	2
209	5
206	2
205	4
203	2
202	4

Subslab diagnostics measurements were performed in the boiler room. Part 1 of the measurement found that the slab was 3 in. thick with a 5.5-in. gravel base. Permeability testing determined that the subslab has a high flow/low pressure characteristic, with considerable communication to the outside. Field extension was estimated to be 18 ft at 1-in. static pressure.

Blower door diagnostics were performed, but the data were inconclusive due to wind. Although unable to quantify, the data do indicate that the building is tightly constructed.

The current forced-air system has no duct work. The air from the units is forced into the suspended ceiling and is delivered into the areas by cutting holes or removing a ceiling tile. In the absence of a supply vent, the flow hood measurements could not be performed.

Radon mitigation should be a phased approach at this site. The first step should be the inspection of the fresh air intake vents on the roof. Based on the ACH data (Table 90), insufficient fresh air is being incorporated into the building. Adjustments should be made to increase the overall air change to a minimal 0.75 $hour^{-1}$, and then retesting should be performed. The estimated cost for this attempt is $700.

An alternative for increased air change is the installation of an HRV unit in the building. In the office wing, the installation of four 700-ft^3/min HRV units (one per quarter slab area) should provide sufficient increase in the air turnover rate to reduce the radon levels. Although not required for radon mitigation, it is recommended from an indoor air quality standpoint, that the USPS side of the building have three 700-ft^3/min HRV units installed as well. The estimated cost for installation of the HRV mitigation system (including ducting) is $28K.

If air change adjustments are unsuccessful, then the DP measurements should be repeated. If the DP measurements in the elevated area(s) are negative, then area and individual room flow adjustments should be made to compensate for this problem. One possibility is the installation of passive wall vents (6 in. × 3 ft) connecting all of the office areas with the central hallway. Another suggestion is to reduce the amount of recycled air from an area. The target overall pressure for the office areas should be +5 Pa to ensure mitigation. The estimated cost for this mitigation attempt is $2K for vent installation and $700 for recycled damper adjustment and installation.

Subslab mitigation would be the next option (if all other ventilation attempts have failed). Installation of six 4-in. PVC suction pits in parallel rows (two rows of three pits each) alternating along the slab centerline within the office wing should be sufficient for reduction. No more than three pits should be connected to a single fan (2.5 in. at 500 ft^3/min). Five similar-size pits should be located on the USPS side of the building at equal distances from each other. All of the pits must be at least 20 ft from the slab edge. The exact locations of the pits should be determined by site personnel and the installation contractor to prevent work area obstruction. Although the negative pressure side of the PVC pipe may be located in the supply plenum, the exhaust fans must be located on the building exterior. Based on the estimated lengths of pipe runs and assuming mostly vertical exhaust stacks, the cost for installation of the SSD system is $17K.

2.19 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN ROCKLAND, MAINE

The main post office in Rockland, Maine, is a two-story, 19,000-ft^2, slab-on-grade building constructed in 1967. The building has new multiple HVAC forced-air systems (installed July 1993). Heating is provided by both a hot water exchanger and compressor. Cooling is provided by compressor (electrical). The fresh air intakes are located on the roof of the building.

During 1992–1993, USPS personnel performed 25 1-year radon measurements. Ten measurements were >4 pCi/L.

In August 1994, the HAZWRAP radon mitigation diagnostic team performed radon mitigation diagnostics at the site. The mitigation diagnostics are summarized in Table 93.

Table 93. Radon mitigation diagnostics summary for the U.S. Post Office in Rockland, Maine

Diagnostics test	Number of tests	Comments
Air change	3	
Blower door	2	
Subslab	Not completed	No building plans and subslab utilities

Table 93 (continued)

Diagnostics test	Number of tests	Comments
Continuous radon measurements	21 measurements	
Flow hood	11	
Radon entry pathway	9	0 to 14 counts per minute
Differential pressure	31	

During the mitigation diagnostics, 21 continuous radon measurements were performed. None of the measurements were >4 pCi/L. The data are summarized on Table 94.

Table 94. Summary of continuous radon measurements for the U.S. Post Office in Rockland, Maine

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	0.2	Postmaster's office
02	0.2	Room 148
03	0.7	Room 207
04	0.6	Supply room off main room
05	0.5	Main room (front left)
07	0.7	Conference room
08	0.4	Main room (front left)
09	0.2	Main room (back left)
10	0.7	Room 158
11	0.7	Main room (back right)
12	0.6	Breakroom
13	0.6	Room 200
14	0.3	Room 146
15	0.5	Room 143
16	0.6	Supply room off main room

Table 94 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
17	0.2	Room 147
18	0.1	Old smoke room
19	0.5	Room 149
20	0.5	Room 157
21	1.3	Room 155

Air change measurements were performed in various rooms in the building. The data are summarized in Table 95.

Table 95. Air change summary for the U.S. Post Office in Rockland, Maine

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
148	101/9346	0.32	Air conditioning on 24 hours
Main room	1A/4855	0.54	Air conditioning on 24 hours
FMHA office	1A/2377	0.52	Air conditioning on 24 hours
148	101/9346	0.26	Air conditioning on 24 hours
Main room	1A/4855	0.38	Air conditioning on 24 hours
FMHA office	1A/2377	0.40	Air conditioning on 24 hours
Supervisor's office	1A/4855	0.48	Air conditioning on 24 hours
Supervisor's office	1A/4855	0.43	Air conditioning on 24 hours

Radon entry pathway diagnostics failed to identify any major radon entry pathways. The data are summarized in Table 96.

Table 96. Radon entry pathway diagnostics for the U.S. Post Office in Rockland, Maine

Hole type	Location	Counts per minute
Drain	Boiler Room 157	1
Power conduit	Boiler Room 157	4
Floor crack	Boiler Room 157	0
Floor	Boiler Room 157	0
Wall-to-floor joint	Boiler Room 157	13
Wall	Room 147	6
Phone jack	Room 147	4
Pipe chase	Room 141	4
Phone jack	Box area	14

DP measurements indicate that the forced-air system is unbalanced. The data are listed in Table 97.

Table 97. Differential pressure measurements for the U.S. Post Office in Rockland, Maine

Location	Differential pressure relative to outdoors (Pa)
Smokers' room	0
Main room	0
Breakroom	-2
Maintenance room	1
Storage room	1
Office	-3
Supervisor's office	-3
Postmaster's office	0
Entry	-4
Box lobby	-5
Control lobby	-12 (suspect)
Hall	-5

Table 97 (continued)

Location	Differential pressure relative to outdoors (Pa)
141	-3
143	-6
144	-5
145	-9
147	-5
149	1
148-46	0
Hall	7
Men's restroom	8
217	14 (suspect)
Women's restroom	12 (suspect)
206	7
207	9
200	9
201	5

Flow hood measurements indicate sufficient flow in the areas tested. The data are summarized in Table 98.

Table 98. Flow hood diagnostics measurement data for the U.S. Post Office in Rockland, Maine

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Room 148	141	174
Room 158	319	337
Room 151	274	318
Room 149	250	342
Room 147	236	278
Room 143	292	402
Room 200	480	584
Room 200-A	441	498
Room 207	511	638

Blower door measurements performed on the GSA wing of the site were inconclusive due to the constant opening and closing of the doors at the site. Although inconclusive, the data do indicate a tight building shell.

The subslab diagnostic measurement could not be performed due to the absence of building plans and the presence of subslab utilities.

Although the building tested negative for elevated radon levels during the on-site investigation (Table 94), the new HVAC system should be balanced. The pressure data (Table 97) indicate a system that needs some adjustment. In addition, it is recommended that long-term testing be performed during the heating season to confirm that radon has been reduced. If retesting shows elevated radon, then the building HVAC system should be adjusted to pressurize the building to +5 Pa. The estimated cost for this adjustment is $700.

2.20 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN SCOTT CITY, KANSAS

The main post office in Scott City, Kansas, is a two-story, 18,000-ft^2, slab-on-grade building constructed in 1965. The building has six new HVAC forced-air systems (installed in 1993). Heating and cooling is provided by gas, while supplemental heating is provided by a hot water exchanger. The HVAC fresh air intakes are located on the roof of the building.

During 1992–1993, USPS personnel performed 19 1-year radon measurements. Five were >4 pCi/L.

In May 1994, the HAZWRAP radon mitigation diagnostic team performed radon mitigation diagnostics at the site (Table 99).

Table 99. Mitigation diagnostics summary for the U.S. Post Office in Scott City, Kansas

Diagnostics test	Number of tests	Comments
Air change	4	
Blower door	Completed	
Subslab	Not completed	No building plans, and subslab utilities
Continuous radon measurements	20 measurements	
Flow hood	12	
Radon entry pathway	25	0 to 6 counts per minute
Differential pressure	First floor: 20 Second floor: 5	Negative pressure Positive pressure

During the mitigation diagnostics, 20 continuous radon measurements were performed. None of the 24-hour average measurements were >4 pCi/L. However, during the night while the air conditioning system is operating at a reduced level, the radon concentration did increase to >4 pCi/L in several offices in the GSA wing. The data are summarized in Table 100.

Table 100. Summary of continuous radon measurements for the U.S. Post Office in Scott City, Kansas

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	1.3	Room 116-B
02	1.7	Room 128
03	1.6	Room 116
05	1.4	Room 114
06	1.7	Main room (front right)
08	2.0	Room 107
09	1.8	Main room (back right)
10	1.9	Room 113
12	1.6	Room 108
13	1.6	Room 106
14	2.2	Main room (front left)
15	1.0	Room 210 (duplicate)
16	1.4	Room 118
17	0.7	Room 205
18	1.5	Postmaster's office
19	1.6	Swing room
20	1.0	Room 210
22	1.6	Room 216
23	0.8	Room 204

Air change measurements were performed in various rooms in the building. Significant reduction in ACH was observed as a function of HVAC cycle. Although radon is under control, the ACH rate in the areas tested is substandard. Adjustments need to be made in the amount of fresh air for the building to increase the ACH to approximately 0.5 $hour^{-1}$. The data are summarized in Table 101.

Table 101. Air change summary for the U.S. Post Office in Scott City, Kansas

Room number	Instrument number	Air change (hour^{-1})	Comments
106	1A/4855	0.14 0.07	Air conditioning on Air conditioning off
114	1A/2377	0.13 0.07	Air conditioning on Air conditioning off
Main room	101/9346	0.05 0.13	Air conditioning off Air conditioning on
Main room	101/9346	0.15 0.25	Air conditioning off Air conditioning on

Flow hood measurements were performed in areas where the supply duct was accessible. Several of the areas tested had no measurable flow, although according to the maintenance staff the areas should. The data are listed in Table 102.

Table 102. Flow hood measurements for the U.S. Post Office in Scott City, Kansas

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Room 204-206	125	125
Room 205	0	0
Room 205-A	0	0
Room 210	117	117
Room 210-B	27	25
Room 210-A	25	23
Main room - near 139	27	25
Main room	32	37
Main room - near 139	30	31
Main room - near 139	27	31
Breakroom	0	0
Breakroom	0	0

Blower door measurements were performed on the GSA office wing. The data indicate that the building shell is not particularly tight. The data are listed in Table 103.

Table 103. Blower door data for the U.S. Post Office in Scott City, Kansas

Location	Flow for 4 Pa (ft^3/min)	Leakage area ($in.^2$)	Room area (ft^2)	Ceiling height (ft)	Room volume (ft^3)
Federal wing	5,058	1,433	3,800	8	30,400

DP measurements were performed in various rooms on the first and second floors of the building (Table 104).

Table 104. Differential pressure measurements for the U.S. Post Office in Scott City, Kansas

Location	Differential pressure relative to outdoors (Pa)
Hallway	-1
Storage room	-1
118	-4
114	-1
113	-2
111	-1
106	-1
Main sorting area	-2
134	-3
135	-4
136	-3
139	-3
128	0
128	-1
128B	-1
Stairwell	-2
Hallway, downstairs	-2
Hallway, upstairs	-1
Hallway, upstairs	-1
210	-1

Table 104 (continued)

Location	Differential pressure relative to outdoors (Pa)
211	0
207	-1

Subslab mitigation diagnostics could not be performed due to the absence of building plans and the presence of subslab utilities.

Based on the data collected, it appears that the new HVAC system has mitigated the radon problem at the site. However, limited continuous data have indicated a trend toward higher radon levels during the night while the HVAC is on limited cycle. The recommendation is made that a 30-day continuous radon measurement be performed at the site during the heating season to ensure radon reduction is permanent. If daytime measurements are elevated, then mitigation could be accomplished by increasing the air change rates in the affected areas. If nighttime measurements are elevated, then a radon management plan (Sect. 2.12) would be the most cost-effective means of controlling personnel exposure.

2.21 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN TALLADEGA, ALABAMA

The main post office in Talladega, Alabama, is a two-story, 18,000-ft^2, slab-on-grade building constructed in 1970. The building has six HAC forced-air systems. Heating is provided by gas furnace, while cooling is provided by compressor. The HAC systems, installed 3 years ago, have no fresh air intakes.

During 1992–1993, the USPS personnel performed 24 1-year radon measurements. Twenty-two measurements were determined to be >4 pCi/L.

In March 1994, the HAZWRAP radon mitigation diagnostic team performed radon mitigation diagnostics at the site (Table 105).

Table 105. Mitigation diagnostics summary for the U.S. Post Office in Talladega, Alabama

Diagnostics test	Number of tests	Comments
Air change	20	Some tests were invalidated due to open doors
Blower door	1	Inconclusive
Subslab	Part 1 completed Part 2 completed	
Continuous radon measurements	21 measurements	
Flow hood	13	

Table 105 (continued)

Diagnostics test	Number of tests	Comments
Radon entry pathway	30	4 to 28 counts per minute
Differential pressure	16	7 neutral 2 positive 7 negative

During the mitigation diagnostics, 21 continuous radon measurements were performed. The data confirms the presence of elevated radon at the site. No significant increase in radon concentration was observed as a function of HAC night cycle. The data are listed in Table 106.

Table 106. Summary of continuous radon measurements for the U.S. Post Office in Talladega, Alabama

Instrument number	48-hour average radon measurements (pCi/L)	Location
02	6.4	Room 112
03	5.8	Room 217
04	6.2	Room 130-A
05	2.9	Main room (center)
06	3.1	Main room (P.O. Box area)
08	4.4	Room 204
09	5.1	Room 214
10	3.8	Main room (front right)
12	3.5	Room 122
13	5.0	Room 130
14	5.2	Room 205
15	3.1	Breakroom
16	10.3	Room 129
17	6.0	Room 108-C
18	3.3	Main room by Room 121
19	7.2	Room 104

Table 106 (continued)

Instrument number	48-hour average radon measurements (pCi/L)	Location
20	5.1	Room 103
21	2.4	Room 108-A
22	6.9	Room 108
23	9.7	Room 114
Fem-Tech-1	8.9	Room 108-C (17)
Fem-Tech-2	4.3	Room 103 (20)
Fem-Tech-3	1.3	Main room (center) (05)

Air change measurements were performed in various rooms in the building. The data indicate significant (factor of 2) increases in ACH as a function of the HAC cycle. Because this is not an HVAC system, the conclusion was made that a fresh air leak must exist somewhere in the return air system. Inspection of the blowers on the roof found significant gaps in the junction between the return air duct and the blower box. The maintenance staff concurred that water (e.g., rain) has been a problem since the system was installed. The air change data are listed in Table 107.

Table 107. Air change summary of for the U.S. Post Office in Talladega, Alabama

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Main room	1A/4855	0.10 0.20	Air conditioning off Air conditioning on
214	101/9086	0.52 0.97	Air conditioning off Air conditioning on
103	1A/2377	0.14 0.30	Air conditioning off Air conditioning on

Subslab diagnostics were performed in two areas of the slab. The data indicate adequate subslab pressure field extension (Table 108).

Table 108. Subslab field extension data for the U.S. Post Office in Talladega, Alabama

Hole 1.50 (in.)	Location	Field extension (ft)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Room 114	11(+)	5	0.5-0.75 gravel	4.5
2	Breakroom	20(+)	5	0.5-0.75 gravel	4.0

Flow hood measurements were performed in various rooms in the building. The data are listed in Table 109.

Table 109. Flow hood measurements at the U.S. Post Office in Talladega, Alabama

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Room 204-B	111	107
Room 112	373	451
Room 108-A	249	281
Room 108-A	321	349
Room 108 (right)	415	589
Room 108 (left)	307	459
Room 108-C	283	342
Room 105	435	539
Room 204 (right)	492	580
Room 204 (left)	332	375
Room 217	453	534
Room 215	61	95
Room 213	458	490

Radon entry pathway diagnostics failed to locate any significant entry pathways. The data are listed in Table 110.

Table 110. Radon entry pathway diagnostics data for the U.S. Post Office in Talladega, Alabama

Hole type	Location	Counts per minute
Phone jack	Room 103	16
Phone jack	Room 103	27
Phone jack	Room 103	20
Electrical outlet	Room 103	19
Phone jack	Room 104	17
Electrical outlet	Hallway near 108	28
Electrical outlet	Room 108-C	10

Table 110 (continued)

Hole type	Location	Counts per minute
Computer cable outlet	Room 108	14
Power cable chase	Room 108-A	12
Wall	Room 112	13
Drain	Hallway near water fountain	19
Wall-to-floor joint	Room 114	9
Electrical outlet	Men's restroom (first floor hallway)	15
Floor crack	Main lobby	22
Window frame crack	Main lobby	8
Door frame crack	Elevator	17
Phone jack	Room 130-A	16
Wall crack	Room 129	8
Wall	Room 128	8
Wall	Main room near safe	20
Floor crack	Room 125	10
Wall-to-floor joint	Main room	12
Wall-to-floor joint	Room 122	24
Wall	Main room near water fountain	12
Wall crack	Main room near box area	7
HVAC vent	Room 108-A	9

DP measurements indicated no significant room-to-room variations. The data are summarized in Table 111.

Table 111. Differential pressure measurements for the U.S. Post Office in Talladega, Alabama

Location	Differential pressure relative to outdoors (Pa)
Office hallway	0
113	0
109	-2
107	-2
111	-1
103	0
112 and 108	-4
108A and 108	-3
113	0
111	-1
107	-1
108	0
104	0
103	1
Lobby	0

Due to the frequent entrances and exits from the main entrance, a stable blow door depressurization curve could not be obtained. However, it was determined from the data that the building shell is not airtight (>2000 in.^{2}).

Around June 1994, GSA installed an SSD system in the GSA office portion of the building (Fig. 11). Follow-up testing by USPS personnel in August 1994 found that mitigation had not been achieved (Table 112.)

Table 112. Postmitigation testing at the U.S. Post Office in Talladega, Alabama

Detector number	Location	Radon (pCi/L)
SM2802	Room 112, file cabinet	5.8
SM2864	Room 108, book shelf	5.6
SM2842	Room 108, counter	2.4
SM2753	Room 108B, file cabinet	4.7
SF3976	Room 108A, file cabinet	2.5
SM2866	Room 114, shelf	4.6

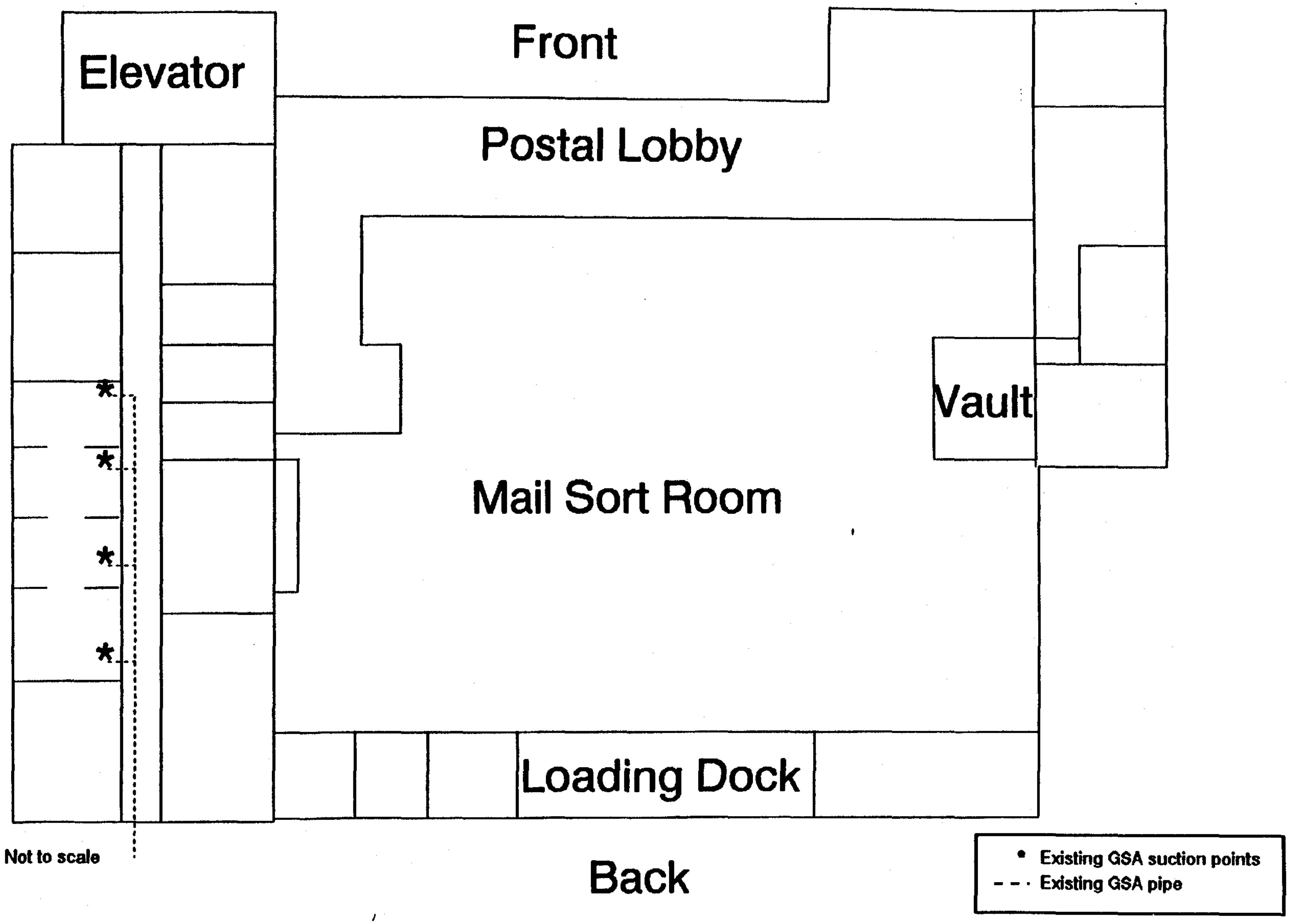


Fig. 11. Ground-floor drawing for the U.S. Post Office in Talladega, Alabama (existing General Services Administration suction points).

SSD mitigation systems are classified as one of two types: high pressure/low flow (HPLF) or low pressure/high flow (LPHF). In an HPLF SSD system, mitigation is achieved by applying a significant vacuum under the slab (pit head pressure >3-in. WC). This subslab vacuum field essentially reverses the flow of air from the building into the subslab zone, thus retarding radon entry. Typical characteristics of HPLF systems are pipe of <3 in. in diameter and a high-pressure (>3-in. WC), low-flow fan (<100 ft^3/min). An HPLF system is installed for slabs that have compacted subslab material (e.g., sand or clay) or for buildings with foundations that have very little communication to the outside. For an LPHF system, mitigation is achieved by the sweeping action of air beneath the slab. A typical LPHF system has pipe >3 in. in diameter and has a high-flow fan (>100 ft^3/min) at low pressure (<3-in. WC). LPHF systems work best in permeable subslab material (e.g., noncompacted stone) or for foundations that communicate to the outside.

Selection of the proper SSD system is essential for proper radon reduction. For example, an HPLF system may not have the flow characteristics to sweep a subslab area. Conversely, an LPHF fan may stall in the absence of air flow. The only way to select the optimal SSD system is to perform the subslab mitigation diagnostics. Part 1 of the test generates a pressure vs flow curve, which enables the selection of the proper mitigation fan. Part 2 defines the extension and characteristics of the pressure field beneath the subslab. When the two diagnostic parts are combined, the type of SSD system is defined. For the U.S. Post Office in Talladega, the mitigation diagnostics data (Table 108) indicate that the subslab has LPHF characteristics. The SSD system installed by GSA is an HPLF system; thus the lack of radon reduction is suspected to be caused by incorrect system installation.

Based on the data collected by the mitigation diagnostic team, the only practical mitigation option is SSD, specifically an LPHF system. To perform this mitigation, the existing GSA SSD system will first have to be removed and a new LPHF system installed in its place. For the new mitigation system, all pipe will need to be 4-in., SCH 40 PVC, and all fans will need to have at least 2.5-in. WC at 400 ft^3/min. Each suction pit will need to be open style, excavated to bare soil (1 ft × 1 ft × 4.5 in.) For the office wing, a total of three SSD systems will be required. With respect to pipe runs, vertical penetration is not possible in the two-story office wing. However, two of the pipes can be run above the suspended ceiling in the hallway to exit the building above the back door. The other office wing pipe run could exit between the junction of the elevator lobby and the office wing (Fig. 12). For the postal part of the building, vertical penetration is possible and is highly recommended. The proposed system consists of nine vertical penetrations with a fan/pipe (Fig. 12). For all pit locations depicted, the option exists for movement within a 6-ft-diam circle to accommodate room functionality and existing obstructions. Networking pipes on the USPS side is not recommended because the cost of connecting the suction pits and the resulting larger fan would more than offset the expense of a single fan. Figure 13 illustrates the exterior view of the mitigation system. The cost for the proposed mitigation system is summarized in Table 113.

Table 113. Radon mitigation cost estimate for the U.S. Post Office in Talladega, Alabama

Description	Estimated cost ($)
Remove and patch holes for existing GSA system	500
Install office wing system	9,000
Install 9 vertical systems in USPS side of building	9,000
Total	**18,500**

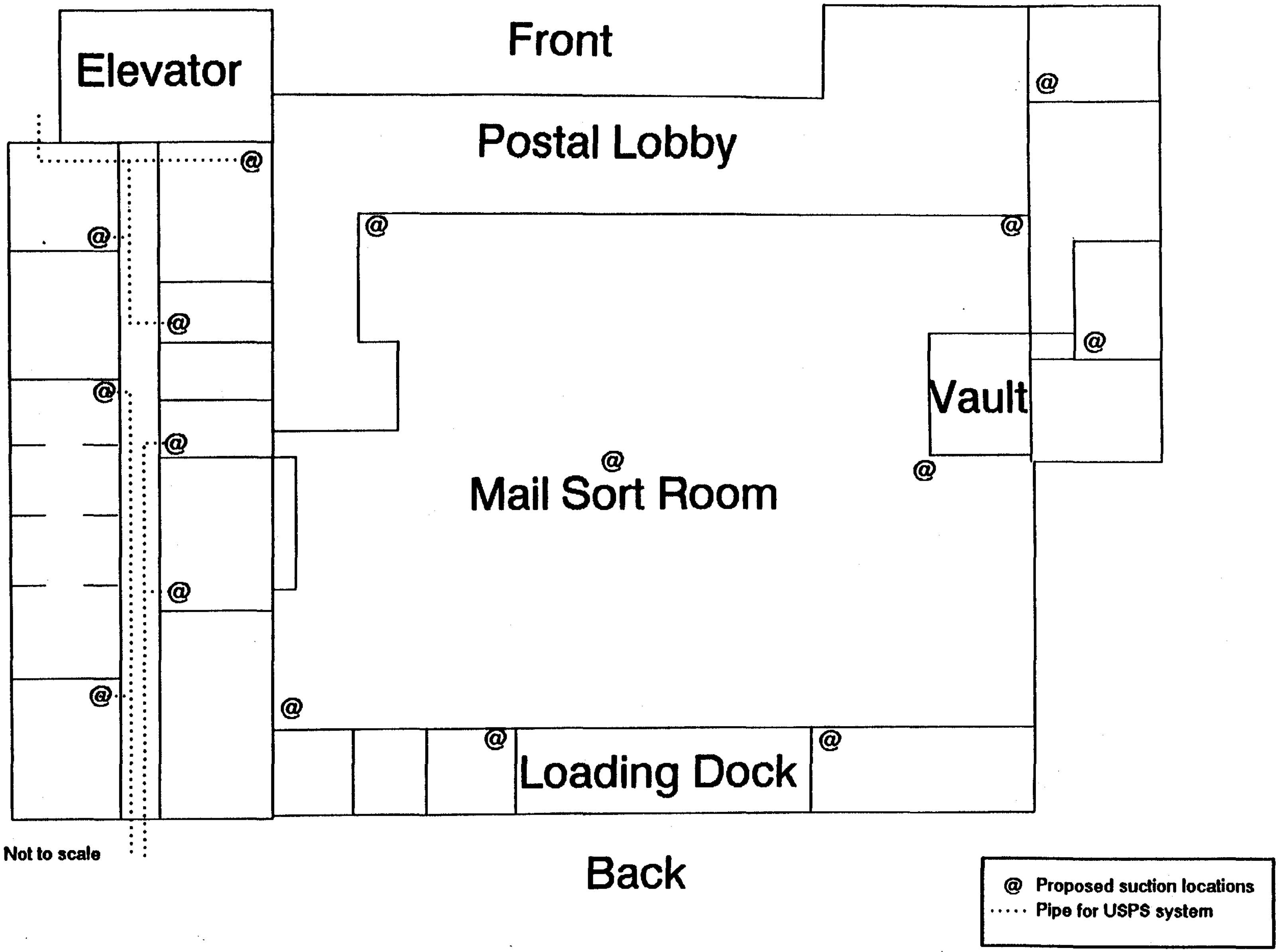


Fig. 12. Ground-floor drawing for the U.S. Post Office in Talladega, Alabama (proposed suction locations).

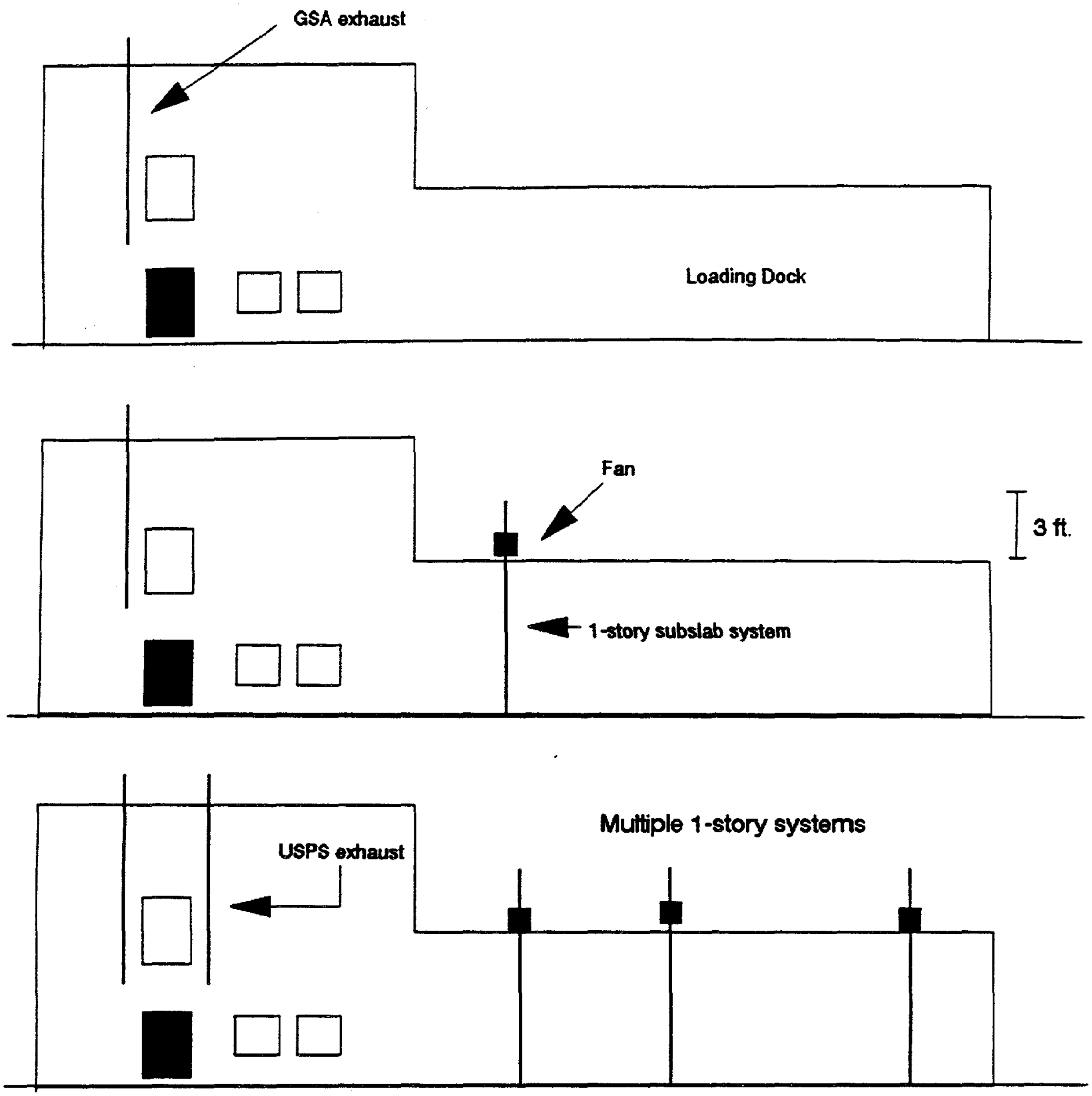


Fig. 13. Exterior of the U.S. Post Office in Talladega, Alabama.

2.22 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN WILLIMANTIC, CONNECTICUT

The main post office in Willimantic, Connecticut, is a leased, one-story, slab-on-grade, 24,000-ft^2 building constructed in 1966. Cooling is provided by a forced-air system powered by an electric compressor located on the roof. Heating is provided by a boiler through hot water exchangers. There are no fresh air intakes for the building. Building renovations are currently under way to expand the loading dock.

During the 1992-1993 USPS radon survey, radon detectors were not placed at the site. Therefore, no USPS radon data are available for the site.

In August 1994, the HAZWRAP radon mitigation diagnostic team conducted radon mitigation diagnostics at the site. A summary of the mitigation diagnostics are listed in Table 114.

Table 114. Mitigation diagnostics summary for the U.S. Post Office in Willimantic, Connecticut

Diagnostics test	Number of tests	Comments
Air change	4	Back dock wall missing
Blower door	Not completed	Renovation
Subslab	Not completed	No plans available, subslab utilities, and asbestos floor tile
Continuous radon measurements	16 measurements	
Flow hood	Not completed	Ceiling was 12 ft high
Radon entry pathway	8	5 to 22 counts per minute
Differential pressure	20	

During the mitigation diagnostics, 16 continuous radon measurements were performed (Table 115). None of the average measurements were >4 pCi/L. However, during the measurements, the loading dock was being reconstructed. Also, the main work room was open to the dock area except for a single plastic barrier. This may have reduced the radon levels in the main room. Additional postconstruction testing is recommended.

Table 115. Summary of continuous radon measurements for the U.S. Post Office in Willimantic, Connecticut

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	0.5	Postmaster's office
02	0.7	Maintenance shop
03	0.7	Classroom
04	0.6	Main room (front right)
05	0.7	Locker room
08	0.6	Breakroom
09	0.6	Supply room
10	1.2	Boiler room
11	0.9	Supervisor's office (annex)
12	0.7	Supervisor's office
13	0.6	Main room (back left)
16	0.8	Top of P.O. Boxes
17	0.4	Probation office
19	0.3	Main room (back right)
20	0.4	Main room (center)
21	0.3	Computer room

Air change measurements were performed in various rooms. Even with the loading dock wall missing, the air change rates are below minimal ASHRAE standards (Table 116).

Table 116. Air change summary for the U.S. Post Office in Willimantic, Connecticut

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Main room (back)	1A/2377	0.34 0.31 0.23 0.23	Air conditioning on Air conditioning on Air conditioning off Air conditioning off
Main room (front)	101/9346	0.15 0.09	Air conditioning on Air conditioning off

Table 116 (continued)

Room number	Instrument number	Air change ($hour^{-1}$)	Comments
Lunch room	1A/2377	0.28 0.17	Air conditioning on Air conditioning off
Classroom	101/9346	0.18 0.15	Air conditioning on Air conditioning off
Supervisor's office	1A/4855	0.32 0.17	Air conditioning on Air conditioning off

Radon entry pathway diagnostics failed to locate any significant entry pathways. The data are listed in Table 117.

Table 117. Radon entry pathway diagnostics for the U.S. Post Office in Willimantic, Connecticut

Hole type	Location	Counts per minute
Electrical outlet	Class room	6
Electrical outlet	Training room	8
Electrical outlet	Supply room	3
Electrical outlet	Breakroom	22
Electrical outlet	Locker room	5
Wall-to-floor joint	Boiler room	7
Drain	Boiler room	5
Wall	Boiler room	7

DP measurements were performed. However, the data are of limited value because the building was under renovation. The DP data are listed in Table 118.

Table 118. Differential pressure measurements for the U.S. Post Office in Willimantic, Connecticut

Location	Differential pressure relative to outdoors
Box lobby	-4
Counter lobby	-4

Table 118 (continued)

Location	Differential pressure relative to outdoors
U.S. probation office	0
Civil service	-6
Postmaster's office	-6
Superintendent's office	-4
Reception area	-5
Main room	-5
Front office	-1
Training office	-3
Women's bathroom	-5
Men's bathroom	-5
Supply room	-4
Stamped envelope room	-4
Lunch room	0
Locker room	-4
Men's bathroom	-3
Postal storage	-4
Mechanical room	-5

Three planned mitigation diagnostics could not be performed. The blower door test was not performed because the back loading dock wall was missing. Flow hood measurements could not be performed because the supply vents were inaccessible (12-ft ceiling). Subslab diagnostics could not be performed due to the absence of building plans and presence of asbestos tile and subslab utilities.

Building renovations, such as those made at this site, can have a significant impact on the radon levels. The recommendation is made that after the renovations are complete, long-term radon testing be performed during a heating season to determine whether the radon levels are above the action level. If they are found to be above the action level, then the recommendation is made that a fresh-air, forced-air HAC system be installed at the site. Sufficient outside air should be incorporated to maintain a minimal 0.5 ACH. The cost for such a system (if needed) is estimated to be $55K.

2.23 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN WATERTOWN, NEW YORK

Radon mitigation diagnostics were not performed at the U.S. Post Office in Watertown, New York (located at 163 Arsenal) because the facility has closed since radon testing was performed in 1992–1993. Therefore, no recommendations are available.

2.24 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN WAYNESVILLE, NORTH CAROLINA

The main post office in Waynesville, North Carolina, is a two-story, slab-on-grade, 19,000-ft^2 building constructed in 1966. During the initial site investigation in April 1994, the building mechanical system consisted of six HAC units, four of which were nonfunctional. At that time, USPS was in the process of replacing the units with six forced-air heat pumps. This installation was completed in August 1994. However, in September 1994, the forced-air system was upgraded to include fresh air intakes.

On April 7, 1994, GSA notified USPS that elevated radon had been detected in the GSA portion of the building. Based on this information and direction from USPS Headquarters, the HAZWRAP radon mitigation diagnostic team performed radon mitigation diagnostics at the site on April 12, 1994. Due to the changes in the ventilation system, the team performed a total of three on-site investigations (April, August, and October 1994). Table 119 summarizes the initial mitigation diagnostics performed at the site in April 1994.

Table 119. Radon mitigation diagnostics summary for the U.S. Post Office in Waynesville, North Carolina

Diagnostics test	Number of tests	Comments
Air change	9	
Blower door	Completed	
Subslab	Part 1 completed Part 2 completed	
Continuous radon measurements	20 measurements	
Flow hood	22	
Radon entry pathway	7	0 to 121 counts per minute
Differential pressure	47	

Continuous radon measurements were performed at the site during the four distinct phases of the HAC installation. Phase 1, preinstallation, was performed during the mitigation diagnostics (Table 120). Phase 2 monitoring spanned the shutdown of the HAC system (Figs. 14–17). Phase 3 monitored the radon levels after the HAC installation and before the installation of the fresh air intakes (Table 121). Phase 4 monitored the radon levels after the installation of the

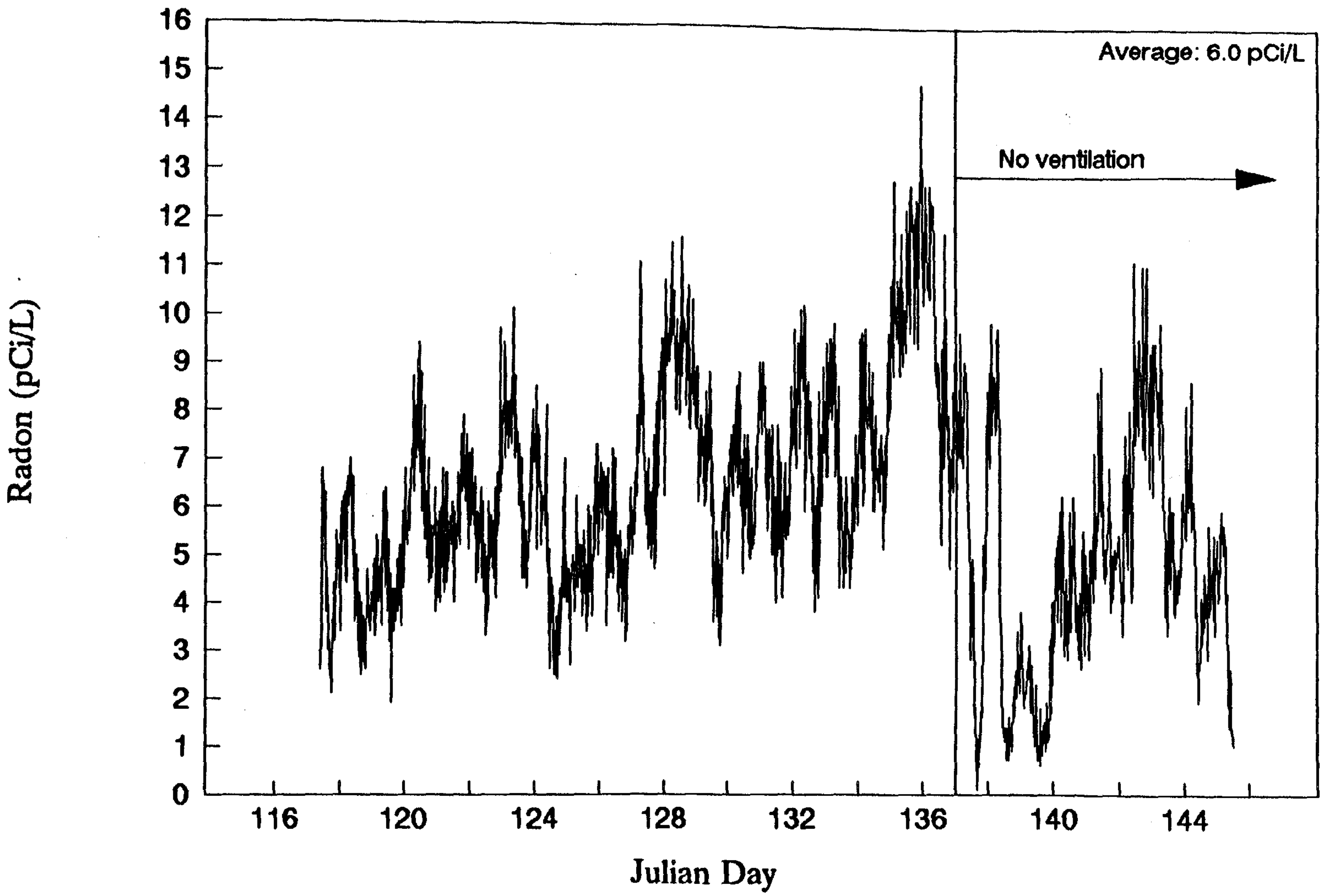


Fig. 14. Radon levels in Room 122B at the U.S. Post Office in Waynesville, North Carolina.

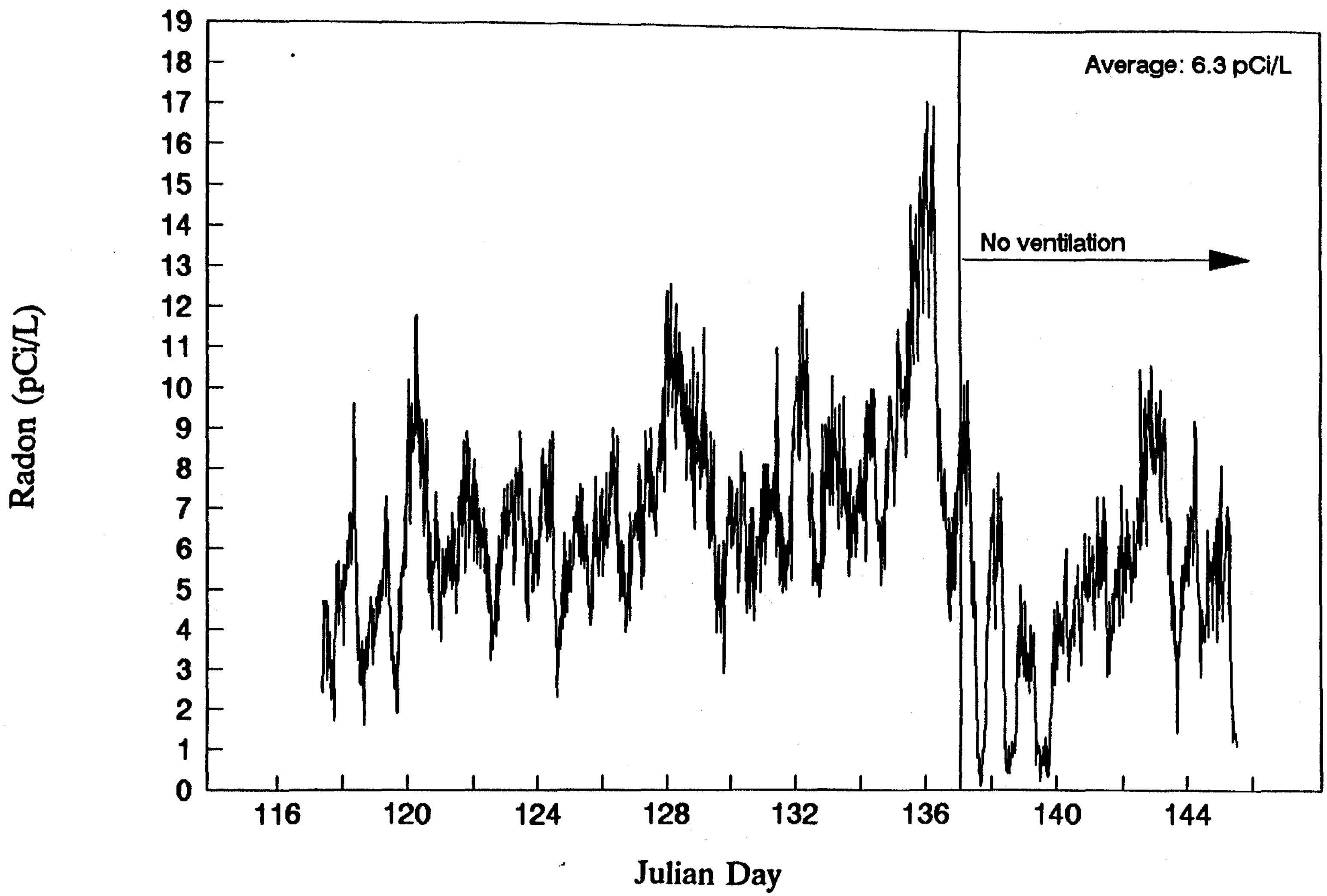


Fig. 15. Radon levels in Room 125 at the U.S. Post Office in Waynesville, North Carolina.

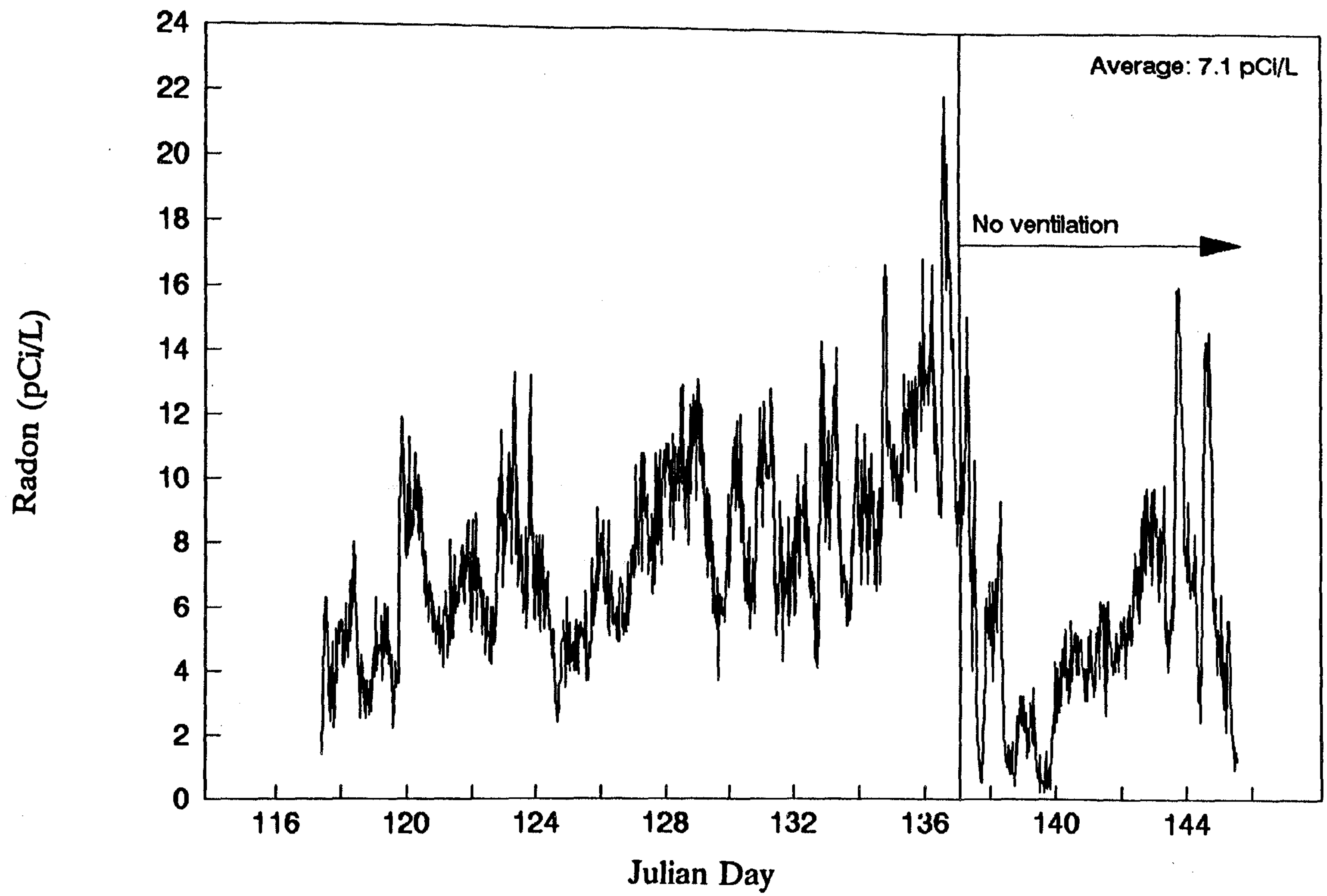


Fig. 16. Radon levels in Room 124 at the U.S. Post Office in Waynesville, North Carolina.

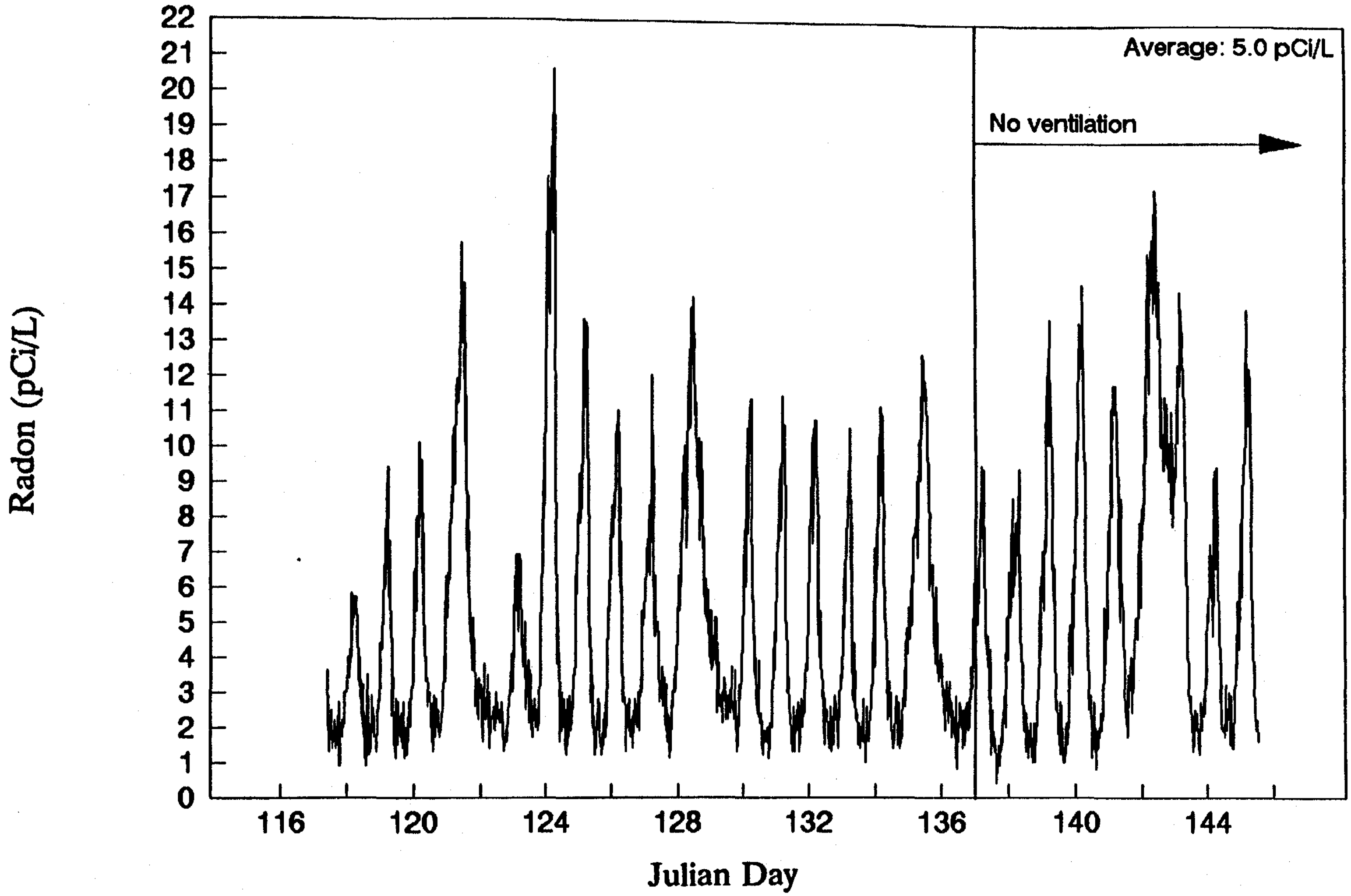


Fig. 17. Radon levels in Postmaster's office at the U.S. Post Office in Waynesville, North Carolina.

fresh air vents (Table 122). Table 123 compares the radon levels for Phases 1, 3, and 4 of the HAC installation.

Table 120. Summary of continuous radon measurements for the U.S. Post Office in Waynesville, North Carolina (April 1994)

Instrument number	48-hour average radon measurement (pCi/L)	Location
03	3.1	Room 207
04	2.9	Room 205
05	2.0	Main room (front left)
06	3.0	Room 203
08	2.2	Main room (back right)
09	7.6	Postmaster's office
10	2.8	Main room (back left)
12	6.6	Room 122-B
13	2.5	Main room (center)
14	5.6	Room 120
15	2.6	Main room (front right)
16	5.7	Room 124
17	4.7	Room 129-B
18	5.8	Room 133
19	5.7	Room 117-A
20	6.3	Room 129
22	5.9	Room 117
23	6.3	Room 129
141	3.6	Computer room
151	6.3	Room 125

Table 121. Summary of continuous radon measurements for the U.S. Post Office in Waynesville, North Carolina (August 1994)

Instrument number	48-hour average radon measurement (pCi/L)	Location
01	6.5	Room 117-A
02	5.5	Room 129
04	4.3	Room 205
05	11.9	Room 122-B
08	2.9	Main room (back left)
09	9.2	Room 124
10	2.7	Main room (front left)
11	2.9	Main room (back right)
12	4.3	Room 203
14	2.3	Room 120
16	4.4	Room 207
17	3.5	Room 133
19	5.2	Room 129-B
20	6.8	Room 117
21	4.9	Room 125

Table 122. Summary of continuous radon measurements for the U.S. Post Office in Waynesville, North Carolina (October 1994)

Instrument number	48-hour average radon measurement (pCi/L)	Location
09	0.8	Room 207
10	1.0	Room 205
15	1.5	Room 203
13	0.5	Main room (back right)

Table 122 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
02	0.2	Postmaster's office
01	0.2	Main room (back left)
16	1.4	Room 122-B
21	0.3	Room 120
18	0.4	Main room (front right)
05	1.2	Room 124
11	1.2	Room 129-B
07	1.8	Room 133
12	1.3	Room 117-A
08	1.1	Room 125
20	0.7	Room 117
14	1.2	Room 129

Table 123. Comparison summary of the continuous radon measurements for the U.S. Post Office in Waynesville, North Carolina

Location	Average radon level in April 1994 (pCi/L)	Average radon level in August 1994 (pCi/L)	Average radon level in October 1994 (pCi/L)
Room 117	5.9	6.8	0.7
Room 117A	5.7	6.5	1.3
Room 122-B	5.7	9.2	1.4
Room 124	6.6	11.9	1.2
Room 125	6.3	4.9	1.1
Room 129	5.5	5.5	1.2
Room 129-B	4.7	5.2	1.2
Room 133	5.8	3.5	1.8

Table 123 (continued)

Location	Average radon level in April 1994 (pCi/L)	Average radon level in August 1994 (pCi/L)	Average radon level in October 1994 (pCi/L)
Breakroom 120	5.6	2.3	0.3
Main room (back left)	2.8	2.9	0.2
Main room (front left)	2.0	2.7	N/A
Main room (center)	2.5	N/A	N/A
Main room (back right)	2.6	2.9	0.5
Main room (front right)	2.8	N/A	0.2
Postmaster's office	7.6	N/A	0.2
Computer room	3.6	N/A	N/A

Air change measurements were performed during Phases 1, 3, and 4 of the HAC installation cycle. Table 124 summarizes the air change measurements for Phases 1 and 3. Table 125 summarizes the air change data for Phase 4.

Table 124. Air change summary for the U.S. Post Office in Waynesville, North Carolina (April and August 1994)

Location	Air change April 1994 ($hour^{-1}$)	Air change August 1994 ($hour^{-1}$)
Main room	0.20 (air conditioning on) 0.19 (air conditioning on) 0.06 (air conditioning off)	0.22 (air conditioning on) 0.18 (air conditioning on)
Computer room	No data	0.20 (air conditioning on)
GSA first floor	0.36 (air conditioning on) 0.16 (air conditioning on) 0.24 (air conditioning on)	0.06 (air conditioning off) 0.04 (air conditioning off)

Table 125. Air change summary for the U.S. Post Office in Waynesville, North Carolina (October 1994)

Location	Air change October 1994 (hour^{-1})
Main room (back)	0.45 (air conditioning on) 0.47 (air conditioning on)
Main room (left)	0.47 (air conditioning on) 0.51 (air conditioning on)
Room 125	0.41 (air conditioning on)

Subslab mitigation diagnostics were performed in the mechanical room (Room 133). The data (Table 126) indicate good field extension beneath the slab.

Table 126. Subslab field extension data for the U.S. Post Office in Waynesville, North Carolina

Hole 1.45 (in.)	Location	Field extension (ft)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Room 133	18	5	2.0 (gravel)	2.5

Blower door measurements were performed on the first-floor office wing of the building. The data indicate that the building shell is very tight (Table 127).

Table 127. Blower door data for the U.S. Post Office in Waynesville, North Carolina

Location	Flow for 4 Pa (ft^3/min)	Leakage area ($in.^2$)	Size area tested (ft^2)	Ceiling height (ft)	Room volume (ft^3)
GSA wing (first floor)	2,119	600	5,800	8	46,400

Radon entry pathway diagnostics identified one marginal entry pathway in Room 118 (floor crack). The remaining measurements were insignificant (Table 128).

Table 128. Radon entry pathway diagnostics for the U.S. Post Office in Waynesville, North Carolina

Hole type	Location	Counts per minute
Wall crack	Room 122	11
Wall	Breakroom	6
Floor	Room 118	121

Table 128 (continued)

Hole type	Location	Counts per minute
Wall	Room 116	10
Electrical outlet	Room 117-A	7
Wall-to-floor joint	Room 117	10
Wall	Room 123	0

Flow hood measurements were performed only during Phase 1 of the HAC installation. The data are summarized in Table 129.

Table 129. Flow hood measurement data for the U.S. Post Office in Waynesville, North Carolina

Location	Uncorrected flow (ft^3/min)	Corrected flow (ft^3/min)
Room 117	133	162
Room 123	172	220
Room 123	107	125
Room 125	102	118
Room 129	203	233
Room 129-B	255	285
Room 203	209	236
Room 203-A	186	213
Room 206	236	290
Room 202	203	227
Room 207	225	297
Room 211	182	220
Room 211	190	281
Room 211-A	247	256
Room 213-A	194	207

DP measurements were performed in various rooms during Phases 1, 3, and 4 of the HAC installation cycle. The data are listed in Table 130.

Table 130. Differential pressure measurements for the U.S. Post Office in Waynesville, North Carolina

Location	Differential pressure in April 1994 (Pa)	Differential pressure in August 1994 (Pa)	Differential pressure in October 1994 (Pa)
Stairwell	No data	-5	5
Main room	-2	-4	2
111	-1	No data	3
110	-2	No data	No data
114	0	No data	3
106	-2	No data	No data
108-B	-2	No data	No data
Lobby	-3	-4	3
Assistant Postmaster's office	-2	No data	2
Postmaster's office	-1	-3	3
Hallway	-2	-6	3
133	-2	No data	0
131	-3	No data	1
129-B	-3	-4	7
129	-2	-3	No data
125	-3	-4	No data
123	-2	-8	No data
117	0	-1	6
116	-1	-7	7
118	-1	-9	1
120	-2	-8	0
122	-1	-9	2
124	-1	-11	2
130	-4	No data	1

Table 130 (continued)

Location	Differential pressure in April 1994 (Pa)	Differential pressure in August 1994 (Pa)	Differential pressure in October 1994 (Pa)
132	-3	-4	2
134	-4	-8	3
Hallway	0	-6	3
212	3	No data	6
213	3	-5	3
211	2	-2	1
216	-3	-8	0
212	-1	No data	0
207	2	-8	5
210	1	-7	3
205	1	-7	1
208	-2	-7	3
206	-1	-6	3
202	-1	-9	5
203	1	-8	1
201	0	-8	6

Based on the most recent radon data (Table 122), the installation of fresh air intakes on the six HAC systems has appeared to have mitigated the elevated radon problem. Currently, long-term radon measurements are being performed to assess whether mitigation has been successful. If unsuccessful, the recommendation is made that the amount of fresh air being incorporated into the building be increased to yield an air change rate of 0.75 $hour^{-1}$. Another mitigation option is the installation of an LPHF SSD system. The installation of four suction pits in the office wing with an additional six single-pipe systems in the USPS wing would perform adequate reduction (Fig. 18). The SSD system should consist of 4-in., SCH 40 PVC and mitigation fans with 2.5-in.-WC pressure and 450-ft^3/min flow. Placement of the suction pits in the exact locations (as shown in Fig. 18) is not essential. The radius of variance for the installation can be up to 9 ft. The estimated cost for the SSD system would be $15K.

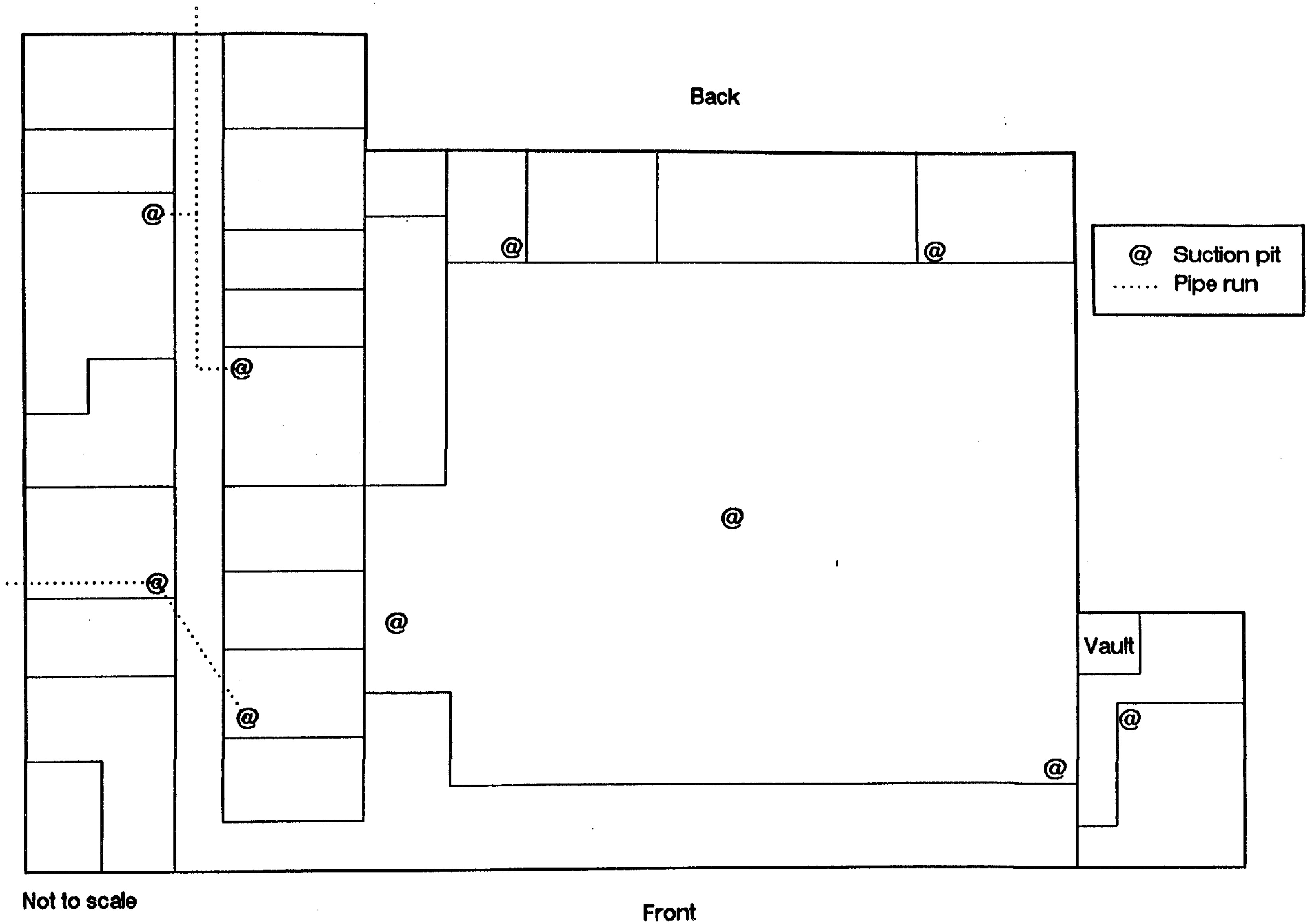


Fig. 18. Subslab mitigation plan for the U.S. Post Office in Waynesville, North Carolina.

2.25 PHASE 2 DIAGNOSTICS AT THE U.S. POST OFFICE IN WRIGHTSVILLE, GEORGIA

The main post office in Wrightsville, Georgia, is a one-story basement building constructed in 1938. The basement is subdivided with mostly concrete and hollow-clay tile walls. The approximately 4,600-ft^2 building had a new HVAC forced-air system installed during the on-site investigation. Both heating and cooling are provided by an electric heat pump. The fresh air intake is located at the back of the building. By design, the basement area has a separate heating and cooling system with no ventilation.

During 1992–1993, USPS personnel performed nine 1-year radon measurements. One of the results was >4 pCi/L.

In March 1994, the HAZWRAP radon mitigation diagnostic team performed radon mitigation diagnostics at the site (Table 131).

Table 131. Radon mitigation diagnostics summary for the U.S. Post Office in Wrightsville, Georgia

Diagnostics test	Number of tests	Comments
Air change	12	
Blower door	Completed	
Subslab	Part 1 completed Part 2 not completed	
Continuous radon measurements	15 measurements	
Flow hood	Not completed	Supply vents to high
Radon entry pathway	7	4 to 340 counts per minute
Differential pressure	19	

During the mitigation diagnostics, 15 continuous radon measurements were performed. One measurement performed in the mechanical room was found to be >4 pCi/L. The data are listed in Table 132.

Table 132. Summary of continuous radon measurements for the U.S. Post Office in Wrightsville, Georgia

Instrument number	48-hour average radon measurement (pCi/L)	Location
04	1.1	Main room (center right)
05	1.2	Main room (back right)
08	1.3	Main room
09	1.3	Main room

Table 132 (continued)

Instrument number	48-hour average radon measurement (pCi/L)	Location
13	0.9	Main room
14	1.1	Postmaster's office
15	1.2	Postmaster's bath
17	0.9	Room 3 (soil office)
18	2.2	Room 8 (storage)
19	1.2	Room 9 (storage)
20	1.5	Room 2 (vacant office)
21	1.7	Room 8 (duplicate)
22	1.2	Room 1 (vacant office)
23	3.9	Mechanical room storage
151	4.1	Mechanical room

Air change measurements were performed in various rooms in the building. Significant differences in air change were observed as a function of the HVAC cycle. To measure the impact on the basement air change rate, the amount of makeup air on the first floor was temporarily increased by approximately 100%. The air change in the basement did not increase. The data are summarized in Table 133.

Table 133. Air change summary for the U.S. Post Office in Wrightsville, Georgia

Room number	Instrument number	Air change ($hour^{-1}$)	Comments	100% added makeup air change ($hour^{-1}$)
Soil office	101/4855	0.04	Blower off	
Mechanical room	1A/2377	1.12	Blower on	1.14
Mechanical room	1A/2377	0.39	Blower off	
Main room	1A/9346	0.20	Blower off	
Room 2	101/4855	0.31	Blower off	

Table 133 (continued)

Room number	Instrument number	Air change ($hour^{-1}$)	Comments	100% added makeup air change ($hour^{-1}$)
Main room	1A/9346	0.45	Blower off	
Room 1	101/4855	0.14	Blower off	
Main room	1A/9346	0.35	Blower on	0.83

Radon entry pathway diagnostics identified one potential entry pathway in the mechanical room (sump pump). The data are listed in Table 134.

Table 134. Radon entry pathway diagnostics data for the U.S. Post Office in Wrightsville, Georgia

Hole type	Location	Counts per minute
Duct passage	Room 9	12
Pipe chase	Room 8	4
Electrical conduit	Mechanical room	12
Sump pump	Mechanical room	340
Door frame	Mechanical room	66
Phone jack	Room 1 right AG. office	50
Phone jack	Room 1 left AG. office	44

The blower door data indicate that the building has a fairly tight shell (Table 135).

Table 135. Blower door data for the U.S. Post Office in Wrightsville, Georgia

Location	Flow for 4 Pa (ft^3/min)	Leakage area ($in.^2$)	Room area (ft^2)	Ceiling height (ft)	Room volume (ft^3)
Basement (half)	2,399	680	1,449	8	11,592
Basement (full)	2,876	815	2,898	8	23,184
Upstairs	868	245	2,898	8	23,184

DP measurements were performed in various rooms of the building during normal HVAC-on cycles. The basement was found to be under negative pressure during the operation of the HVAC blower. The data are listed in Table 136.

Table 136. Differential pressure measurements for the U.S. Post Office in Wrightsville, Georgia

Location	Differential pressure relative to outdoors (Pa)
Stairwell (back)	7
Main room	6
Main room	8
Postmaster's office	7
Postmaster's bathroom	7
Lobby	7
Hallway	3
8	2
9	2
2	5
Left door	5
Right door	3
Stairwell (right side)	1
Mechanical room	-4 (HVAC on), 0 (HVAC off)
Mechanical Room 2	-4 (HVAC on), 0 (HVAC off)

Subslab diagnostic measurements indicated excellent permeability beneath the slab. Field extension was estimated to be more than 24 ft at a pit-head pressure of 1.5-in. WC. A naphthalene-based tar barrier, approximately 0.5 in. thick, was found between the slab and the aggregate layer. The subslab diagnostic data are summarized in Table 137. Due to a high ceiling, the flow hood diagnostic measurement could not be performed.

Table 137. Subslab mitigation diagnostics data for the U.S. Post Office in Wrightsville, Georgia

Hole 1.45 (in.)	Location	Field extension (ft)	Slab thickness (in.)	Type subslab material (in.)	Subslab fill depth (in.)
1	Boiler room storage	24+ (1.5-in. WC)	7	River rock, 0.5-1 (prewashed)	6

For this building, many mitigation options exist. Pressurization of the basement could be accomplished with the addition of 4,000 ft^3/min of outside air. Use of the existing basement air handler with the addition of a fresh air intake would suffice. However, the basement system is 20+ years old and it would require a major overhaul or replacement before utilization as a pressurization system. A more attractive option would be to tap into the new first-floor mechanical system. Based on HVAC diagnostics performed by the team, the system is oversized and would have ample capacity to service the basement and first floor. To utilize this system, new supply and return ducts would have to be added to all rooms in the basement. Also, additional dampers need to be added to adjust the amount of fresh air intake for the basement and the upstairs. In addition, the vented exterior doors in the mechanical room would need to be replaced with solid doors. Because the existing mechanical blower air change is already high in the mechanical room (Table 133), increasing its ventilation rate would not be a feasible option. However, basement pressurization would be an option. According to the diagnostic data, 4,000 ft^3/min of fresh air intake would pressurize the basement sufficiently for radon reduction. The estimated cost for installation of a basement pressurization system as described is $10K.

Another, more attractive, option is the installation of a three-pit LPHF SSD system. Due to the subslab permeability characteristics, a 4-in. SCH 40 PVC attached to a single 2.5-in. WC, 450-ft^3/min fan is recommended. The suction pits (Fig. 19) should be networked in the basement to a single exhaust pipe that exits the building through the old chimney. Exhaust should be approximately 1 ft above the existing chimney line. The estimated cost for the installation of the SSD system is $6K.

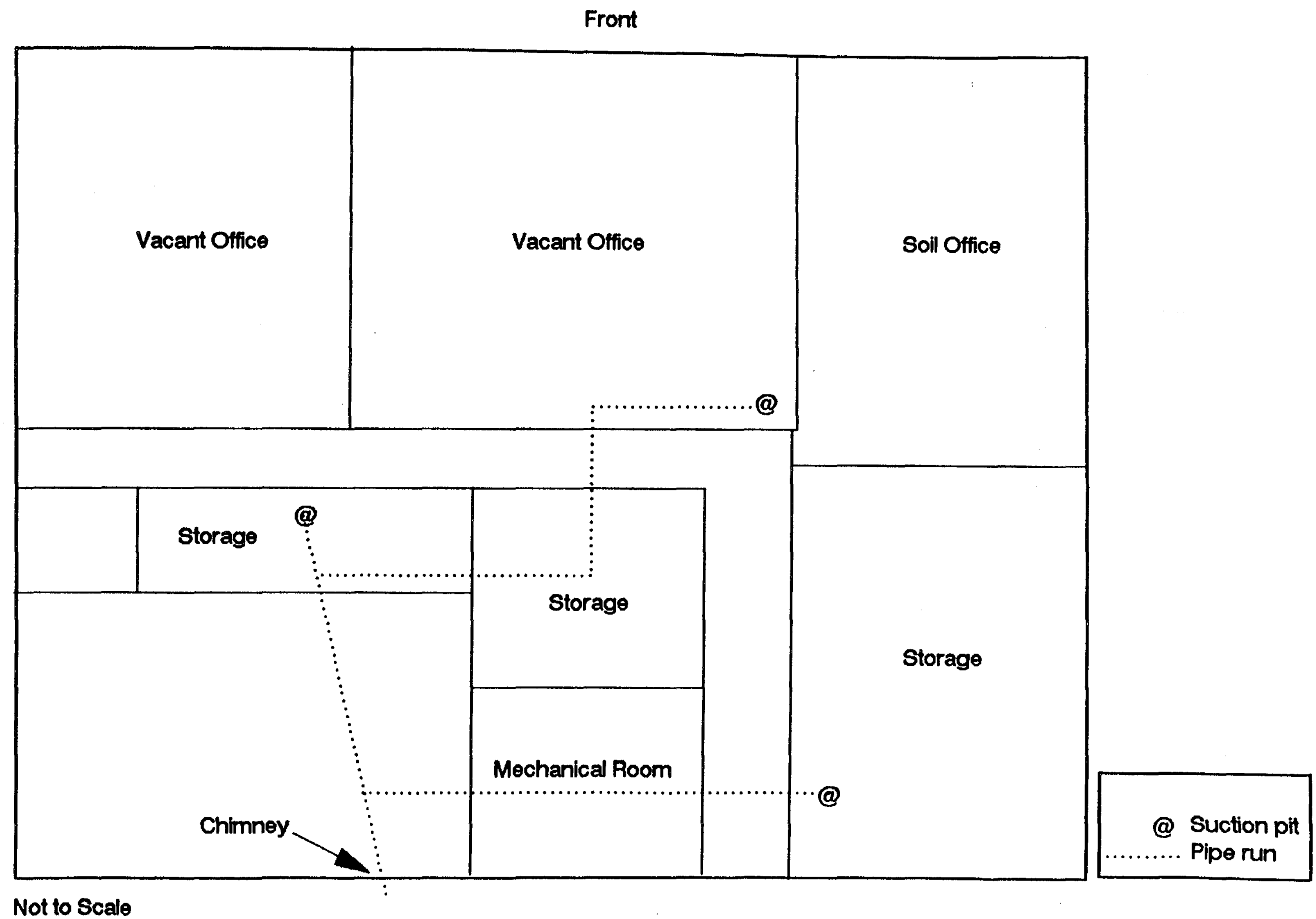


Fig. 19. Subslab mitigation plan for the U.S. Post Office in Wrightsville, Georgia.

3. SUMMARY

Over the past several years, HAZWRAP has generated a significant quantity of radon testing and mitigation diagnostic data for the USPS. These radon data sets represent one of the largest and finest data sets for large buildings anywhere in the world. An in-depth analysis of all of the information generated thus far would entail a considerable effort and is beyond the current project scope. This section deals with general conclusions, observations, and assessments that have been generated thus far in the program. As these studies progress, proposed amendments to the affected protocols will be forwarded to USPS Headquarters for consideration.

3.1 RADON TESTING

Based on the data collected thus far by USPS, no definable way exists to predict the presence or absence of elevated radon levels within a ground-contact room of a USPS structure without testing the room. Computer simulations performed on the collected data using a fixed 2,000-ft^2 sample density failed to identify 50% of the buildings with at least one reading above the 4-pCi/L action level. During the pilot program, upper-floor (non-ground-contact) radon testing was performed at certain sites. In the cases where elevated radon levels were detected on the upper floors in the building, elevated ground-contact levels were also measured. The testing of all ground-contact rooms, stairwells, and interfloor conduits for radon is recommended to be continued.

3.2 CONFIRMATION TESTING

Regardless of the level of quality assurance (QA)/QC, and because of the nature of the testing device, false positives will occur. Unexpected problems identified during the pilot program, such as dust, and expected problems, such as tampering, have resulted in a significant number of false positive measurements. Short-term, follow-up measurements have assisted greatly in the elimination of these erroneous measurements. From a conservative standpoint, all elevated readings (i.e., >4 pCi/L) should be confirmed. The disadvantage of this approach would be an increase in the number of measurements for the full-scale program (15,000 estimated). From the data collected thus far, buildings with multiple readings >4 pCi/L (e.g., three or more) have been confirmed repeatedly during the pilot program. Therefore, confirmation of all radon readings >4 pCi/L for buildings with three or fewer readings above the action level is recommended.

3.3 CONTINUOUS MONITORING

Even if radon above the action level is detected, the possibility may exist for certain types of buildings that the elevated radon may not be present during normal work hours, specifically in those buildings with a forced-air system that is reduced or shut down during the nonshift hours. A recent example of this type of problem was discovered in the U.S. Post Office in Griffin, Georgia (Fig. 20). During normal work hours, the HVAC system provides adequate radon mitigation. However, in the evening, use of the HVAC system is greatly reduced. In this case, passive testing indicated radon levels above the action level. But the continuous measurements

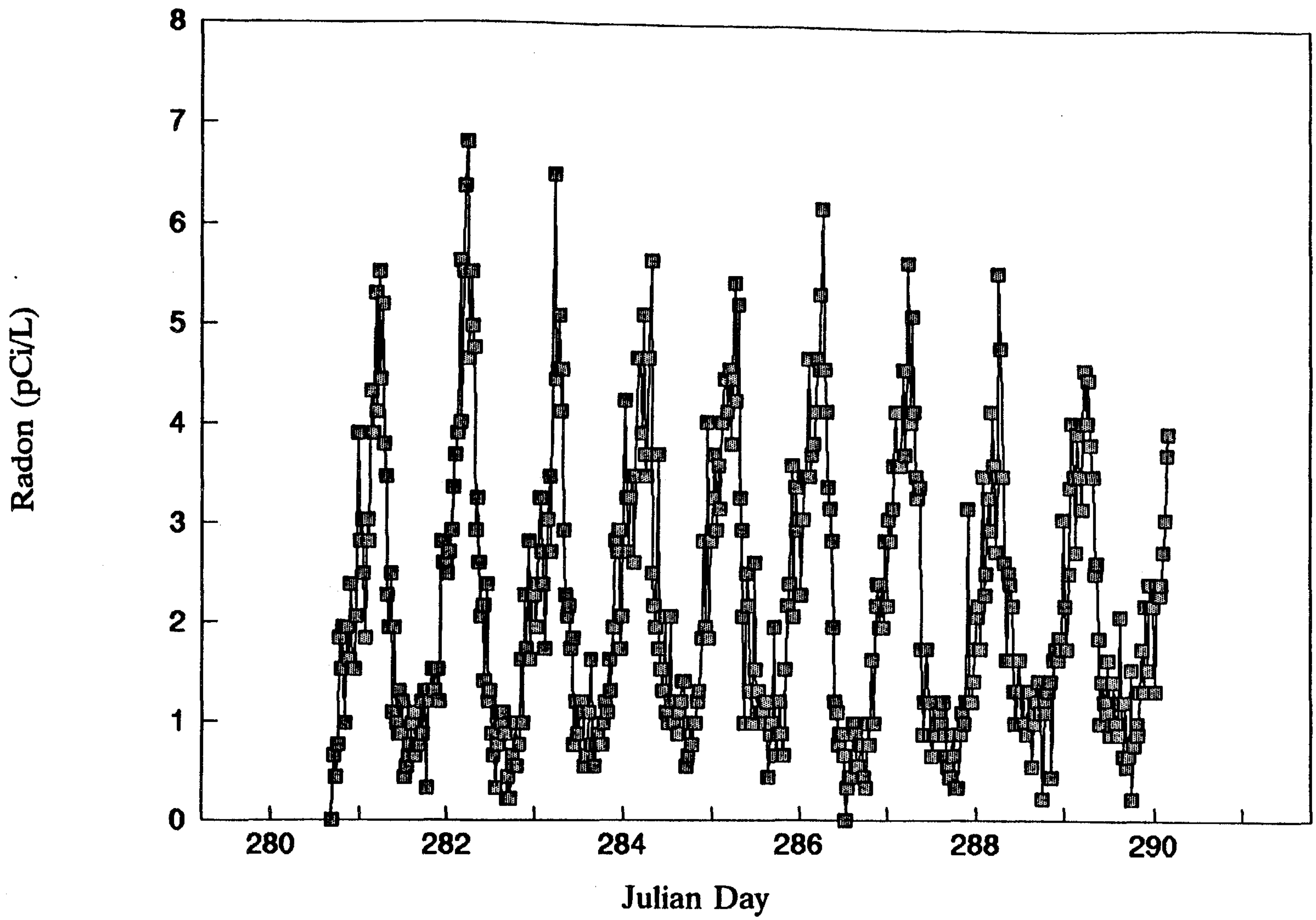


Fig. 20. Mechanical suppression of radon at the U.S. Post Office in Griffin, Georgia.

indicated a problem only during the nonshift hours. For radon to be considered a risk, people must be exposed to the radon; if no one is present, the risk is nonexistent.

In buildings containing annual forced-air systems with energy reduction cycles, before radon mitigation, continuous radon measurements are recommended in areas that have tested above the action level. Based on the data collected, the duration of the test should be at least 21 days. Integrated resolution of the instrument should be on the order of one measurement per 0.5 hour. In addition, the instrument should have a time and date stamp to document the time and date of the measurement.

3.4 RECOMMENDED ACTION LEVELS

Although no radon action levels for the workplace have been announced, EPA has stated that the risk associated with the residential action level (4 pCi/L) is still sufficient to warrant a similar response in the work place. In the most recent *A Citizens' Guide To Radon*, Second Edition (ANR-464, May 1992), EPA discussed the risk associated with radon exposure but omitted discussions regarding the lead time during which corrective action should occur. The reason for the omission is that EPA considers any elevated radon exposure to be a concern requiring immediate corrective action (e.g., within a few months). This approach is practical for a homeowner who has a radon problem. In most parts of the United States, residential radon mitigation is only a phone call and $1,500 (average) away. Large buildings, on the other hand, pose problems that complicate radon mitigation. Multiple mechanical systems and complex substructures are just a few examples of the problems that could impede radon mitigation.

Another mitigation consideration for USPS is the number of buildings. Current projections indicate that USPS will have between 1,800 and 3,600 buildings requiring corrective action. Even assuming that infinite financial resources were available, it would still be impossible to mitigate all of these buildings within a few months. For example, the proposed mitigation solution for the U.S. Post Office in Marion, Indiana (Sect. 2.16) would require the installation of a new HVAC system. These mechanical systems are not "off-the-shelf" items and usually require several years from conception to completion (e.g., design, bidding, procurement, and installation steps). Clearly what is needed are internal USPS guidelines regarding radon mitigation. The proposed time line (Table 138) is based on recommendations made by EPA in the first version of *A Citizen's Guide To Radon* (OPA-86-004).

Table 138. Proposed U.S. Postal Service corrective action guidelines as a function of radon concentration

Exposure radon level (pCi/L)	Action
0 to 3.9	No further action
4 to 20	Corrective action within 5 years
20 to 199.9	Corrective action within 1 year
200	Corrective action within a few months

However, these proposed guidelines should not replace common sense. Radon exposure risk, like all radiological exposure, is based on dose [concentration × duration (hour)]. The dose should factor into the mitigation consideration and prioritization. A good example would be the radon problem in the vault at the U.S. Post Office in Okmulgee, Oklahoma (DOE/HWP-140). The vault (Vault 19), located in the basement of the building, has been used for surplus equipment storage for the past 10 years. Radon testing conducted by USPS personnel in 1993 yielded a 6.4-pCi/L reading in the vault. According to site personnel, the mitigation diagnostic team had been the only people in the vault over the past several years. Obviously, mitigation of the vault in its current utility is not a priority. A management-in-place plan controlling access would be the most cost-effective solution. The recommendation is made that over the long term, USPS develop mitigation response guidelines based on levels of exposure dose as opposed to integrated radon concentration.

3.5 TESTING CONSIDERATIONS

Over the past several years, many observations were noted during radon testing in USPS facilities. The largest concern is detector deployment. During both the protocol evaluation phase and pilot program, certain sites were mailed detectors. At some sites, delays in detector deployment were encountered. An important factor in cost containment using reusable radon detectors is prompt deployment and retrieval. For sites requiring less than 40 detectors, the recommendation is made that site personnel be responsible for deployment. For sites between 40 and 100 measurements, the site should be contacted and a decision made as to whether on-site placement is needed. For sites requiring more than 100 measurements, on-site placement is highly recommended.

3.6 MITIGATION DIAGNOSTIC MEASUREMENTS EVALUATION

During the mitigation diagnostic protocol study (Sect. 2), seven different diagnostics were performed. As required by USPS, the diagnostic measurements performed were similar to residential diagnostics, provided useful information about certain aspects of the buildings, and were nondisruptive to USPS activities. However, observed limitations for each of these tests have an impact on their usefulness. Table 139 lists the diagnostics performed, limitations, and recommendations.

Table 139. Mitigation diagnostics measurement summary

Diagnostics test	Limitations	Recommendations
Air change	Measurements must be taken for both on and off cycles in forced-air locations	Perform at all sites
Blower door	Buildings or areas larger than 8,000 ft^2 yield inconclusive results	Limit to buildings of <8,000 ft^2

Table 139 (continued)

Diagnostics test	Limitations	Recommendations
Subslab	Multistory buildings hamper SSD systems	Limit only to buildings in which a subslab mitigation system can be installed
Continuous radon measurements	Costs of continuous measurements are high compared with costs of passive measurements	Perform in all buildings with forced-air systems
Flow hood	Accessibility to many supply vents complicates the measurements	Differential pressure measurement is a better imbalance indicator
Radon entry pathway	In 26 on-site investigations, only one significant pathway was encountered	Perform only for obvious entry pathways
Differential pressure	Cyclic and seasonal forced-air systems may not be operational during diagnostics	If a seasonal or cyclic forced-air system is present, two measurements (on and off) must be performed

3.7 BUILDING CLASSIFICATION FOR MITIGATION DIAGNOSTICS

An essential part of contracting mitigation diagnostics in the future will be the ability to classify buildings into particular categories, with standardized mitigation diagnostics for each type. Based on the data collected thus far, two classifications exist for USPS buildings: mechanical system and structural.

3.7.1 Mechanical System Classification

The mechanical system category can be subdivided into eight different types, with the criterion being forced air. Table 140 summarizes the possible types of mechanical systems in USPS buildings.

Table 140. Types of forced-air systems in U.S. Postal Service buildings

Type	Forced-air heating	Forced-air cooling	Forced-air ventilation
1	No	No	No
2	No	Yes	No
3	No	Yes	Yes
4	No	No	Yes

Table 140 (continued)

Type	Forced-air heating	Forced-air cooling	Forced-air ventilation
5	Yes	No	No
6	Yes	Yes	No
7	Yes	No	Yes
8	Yes	Yes	Yes

After elevated radon levels have been confirmed (e.g., passive short-term measurements) in a USPS building, the first steps of the mitigation process should entail the inspection of the mechanical system. The inspection should be conducted by an ASHRAE-certified engineer with both diagnostic and estimator qualifications. Table 141 summarizes important questions that must be addressed during the inspection concerning mechanical type. In addition to these questions, the inspector should try to correlate elevated radon levels to areas of the building with poor ventilation (e.g., no forced-air supply). Also, as part of the mechanical inspection, 21-day continuous radon measurements should be recorded for Mechanical Types 4, 6, and 8 in all rooms (or representative subset) with elevated levels of radon. For seasonal forced-air systems (e.g., Mechanical Types 2, 3, 5, and 7), continuous radon measurements should be performed in both the on and off cycles, weather permitting.

Table 141. Questions for inspections of mechanical systems

Question	Mechanical type[a]
Is the forced-air system continuous, seasonal, or intermittent?	2, 3, 4, 5, 6, 7, 8
Does the system operate within specifications?	2, 3, 4, 5, 6, 7, 8
Can the system be upgraded?	4, 6
Should the system be continuous?	4, 6, 8
Can the system be modified to provide year-round service?	2, 3, 5, 7
Is localized ventilation possible?	1, 2, 3, 4, 5, 6, 7, 8
Can the system be adjusted?	4, 6, 8
Should the system be replaced?	2, 3, 4, 5, 6, 7, 8

[a] See Table 140 for types.

The mitigation diagnostics listed in Table 138 can also be considered mechanical or structural (Table 142).

Table 142. Mitigation diagnostic classification

Mitigation diagnostics	Abbreviation	Type
Air change per hour	ACH	Mechanical
Blower door	BD	Mechanical
Subslab	SS	Structural
Continuous radon monitoring	CRM	Mechanical
Flow hood	FH	Mechanical
Radon entry pathway	REP	Structural
Differential pressure	DP	Mechanical

Each mechanical type (Table 140) has mitigation diagnostics that would be recommended (Table 143).

Table 143. Recommended diagnostics for mechanical systems[a]

Mechanical Type	Air change	Blower door	Continuous radon measurements	Flow hood	Differential pressure
1	Yes	Yes	Yes	No	No
2 (year-round)	Yes	Yes	Yes	No (Yes)	No (Yes)
3 (year-round)	Yes	Yes	Yes	No (Yes)	No (Yes)
4	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	No	No
6	Yes	Yes	Yes	Yes	Yes
7	Yes	Yes	Yes	No	Yes
8	Yes	Yes	Yes	Yes	Yes

[a]See Tables 140 and 141 for descriptions.

3.7.2 Structural Classification

Over the past 3 years, the HAZWRAP mitigation diagnostic team has visited 26 USPS buildings. Information regarding building size, age, and substructure type has been taken into consideration, and the buildings have been classified into eight distinct categories (Table 144). For reference purposes, the sites visited by the HAZWRAP mitigation diagnostic team are listed in Table 145. The structural categories are far from being complete. Based on the observations made by the radon detector placement team, this list represents half of the USPS population observed thus far. Full diagnostic testing (Table 139) is recommended for each type of new building until a generalized list is completed for all types of USPS buildings.

Table 144. U.S. Postal Service structural types observed to date

Type	Number observed	Description of structure
1	6	Large, Works Progress Administration style, multistory
2	4	Small, single story with basement
3	3	Multistory, modern
4	2	Extra large, many stories
5	7	1 story plus 2-story office wing
6	1	Pre-Works Progress Administration, multistory
7	2	Single story, modern
8	1	Large, multistory, multiaddition

Table 145. Structural classification of the study sites

Location	Structural type[a]
Abilene, Texas	4
Ada, Oklahoma	1
Allentown, Pennsylvania	1
Big Springs, Texas (mixed substructure)	3
Clovis, New Mexico	3
Dallas, Texas	4
Eastport, Maine	6
Eldora, Iowa	2
Enid, Oklahoma	1
Florissant, Missouri (leased)	7
Griffin, Georgia	3
Lancaster, Ohio	8
Lowville, New York	2
Machias, Maine	5
Marion, Indiana	1
Mercer, Pennsylvania	2

Table 145 (continued)

Location	Structural type[a]
Okmulgee, Oklahoma	1
Paris, Kentucky	5
Pueblo, Colorado (mixed substructure)	1
Raton, New Mexico	5
Rockland, Maine	5
Scott City, Kansas	5
Talladega, Alabama	5
Willimantic, Connecticut (leased)	7
Waynesville, North Carolina	5
Wrightsville, Georgia	2

[a]See Table 144.

Although a mechanical classification may require that a particular diagnostic test be performed (Table 143), certain structural features (e.g., size) may limit the applicability of the data. These technological limitations will take precedence over certain mechanical diagnostics. Table 146 summarizes the recommendations for structural and mechanical diagnostics as a function of structural type.

Table 146. Recommended structural mitigation diagnostics

Structural type	BD[a]	SS[a]	REP[a]
1	No	No	Yes
2	Yes	Yes	Yes
3	Yes	Yes	Yes
4	No	No	Yes
5	Yes	Yes	Yes
6	Yes	Yes	Yes
7	Yes	Yes	Yes
8	No	No	Yes

[a]See Table 142.

3.8 MITIGATION DIAGNOSTIC PROTOCOL

In a diverse population of buildings, such as those of USPS, no single radon mitigation protocol can predict with absolute certainty the best mitigation method. For this reason, the protocol has been developed in steps that allow the user to collect information and either implement the conclusions of that step or proceed to the next step. Also, the option to skip a step exists, based on building circumstances. In certain cases, contracting all or most of the mitigation diagnostics (Table 139) as a package may be more cost-efficient. Keeping accurate records and active data bases for the first few hundred radon mitigations will allow for adaptation and save money over the long term.

3.8.1 Step 1: Building and Mechanical Classification

Using Tables 140 and 144, classify the mechanical and building structures. Then select from Tables 143 and 146 the mitigation diagnostics to perform. If the building has a Type 1, 2, 3, 4, 5, or 7 mechanical system, then consideration may be given to skipping Step 2. However, ACH measurements are recommended as are BD measurements where size permits.

Note that, based on the studies at USPS Waynesville, North Carolina (Sect. 2.24), complete ground-contact testing should be performed after each mitigation attempt. In the case of the U.S. Post Office in Waynesville, the installation of a new HAC system resulted in mitigation in some areas but significant increases of radon in others. Short-term radon testing after a mitigation attempt would be sufficient to establish a baseline. However, only long-term testing results should be used as proof of mitigation.

3.8.2 Step 2: Mechanical Inspection, Assessment, and Diagnostics

During the 1994 mitigation diagnostic study (Sect. 2), the most common problem observed was localized poor ventilation. The poor ventilation problem, caused by improper forced-air system balance, malfunctioning mechanical systems, or no ventilation, was probably the most common reason for elevated radon levels in USPS buildings. The radon test data generated to date (Sect. 1) indicate that elevated radon level in USPS buildings tend to be localized within buildings. This information, coupled with the field air change measurements, clearly indicates that mechanical/ventilation inspection should be the first investigative step of the mitigation process. The objective of the mechanical/ventilation inspection should be to determine the best mechanical options (Table 141) for mitigation and estimate costs for the solution. To assist in this determination, mechanical mitigation diagnostics (Tables 143 and 146) are performed. The order in which the diagnostic tests are performed is not critical.

Once the data have been collected, the following general rules will assist in data interpretation:

- Areas in which the ACH is below 0.35 is considered substandard. By increasing an area's ACH, radon is comparably reduced (see Sect. 2).

- For pressurization, a BD measurement with a 4-Pa pressure ratio of 8 or greater [e.g., volume (of area)/ft^3/min^{-1} for 4 Pa] is considered suitable for SP.

- If no part of the mechanical system is in ground contact, DP measurements in areas with 3 Pa or greater of pressure (relative to the outdoors) can be ignored. In areas with measurements of <3 Pa, adjustments should be made to the area supply to provide, at a minimum, 3 Pa of pressure.

- If elevated radon levels are found only in a few areas (i.e., <4 areas) with low ACH (e.g., <0.35), then serious consideration should be given to increasing the localized ventilation rate first.

Concurrent with the mechanical inspection, a usage or occupancy pattern study should be conducted, because some areas with elevated levels of radon may not have usage sufficient to justify the cost of corrective action (see Sect. 3.4). Also, in certain cases, relocation from a "high radon" area to a "low radon" area within the building may be an option (see USPS Allentown, Pennsylvania, DOE/HWP-140).

3.8.3 Step 3: Structural Mitigation Diagnostics

During the 1994 mitigation diagnostic study, it became apparent that although subslab mitigation diagnostics could be performed, certain building characteristics made installation of a SSD system impractical. Therefore, the first step for subslab mitigation diagnostics should be an assessment of the practicality of an SSD system. Conditions that would potentially disqualify a building from SSD mitigation are as follows:

- Buildings with more than three stories (e.g., >40 ft from slab to roof).
- Historical buildings that cannot be modified on the exterior and for which vertical penetration is not practical.
- Building interiors without easy access to the roof (e.g., single fan pipe runs of more than 100 ft).
- Buildings constructed over shallow water tables (e.g., water table <4 ft from the slab).
- Buildings with extra thick (i.e., 1 ft) or steel-reinforced slabs (would increase installation cost greatly).

If one or more of the above statements are true, then performing subslab diagnostics is not recommended.

If the building is found suitable for potential SSD mitigation, then the building plans should be reviewed. During the review, all subslab utilities (e.g., water, sewer, and electrical) should be identified on the building plans. A walk-through of the building is then conducted to verify the accuracy of the drawings. Hazards, such as asbestos in floor tile, should be documented during the visual inspection. In addition to reviewing the building plans, the building maintenance staff should be consulted. Concurrent with the subslab utilities inspection, avenues for running SSD pipe should be documented as well.

After the walk-through inspection, subslab diagnostics can then be performed in areas where a potential suction pit could be installed. The exact number of subslab diagnostics to perform for a given building depends on many variables; size of the slab, subslab complexity, the measured field extension, details of the building plans, and the number of areas in which subslab diagnostics can be performed are just a few of the variables. For reference purposes, one subslab diagnostics should be performed for each foundation present. For example, a single perimeter, rectangular foundation with a monolithic slab could be characterized with only one subslab diagnostic test if the building plans indicate homogenous subslab fill. In cases where more than one foundation exists (e.g., multilevel basement or building additions) or where the foundation is composed of nonhomogeneous subslab fill, then one subslab diagnostic test should be performed per section (provided elevated radon levels are present in those areas).

The second structural mitigation diagnostic, radon entry pathway measurements, should be performed in all buildings. The exact number of measurements will vary from building to building. All major ground-contact blemishes (or a representative sample) should be examined for radon entry pathways. Examples of blemishes are holes or breaks in the slab with visible subslab material, sumps, loose-fit slab penetrations, and expansion joints. Small slab and wall cracks (e.g., <3/8-in. cross section) can be ignored. The significance of the measurement depends on the volume of the room, room ACH, concentration of the soil gas, and estimated radon flux.

3.8.4 Mitigation Design

Once the diagnostic data have been collected, cost estimates should be prepared for each of the suitable mitigation options. Options such as whole building and localized mitigation should be considered as well. In addition to the installation cost, lifetime energy cost should be integrated into the bottom line. The following issues should also be addressed.

- Difficulty in installation
  - Is the lead time required for mitigation greater than the guidelines allow (Table 138)?
  - Are the chances for successful mitigation acceptable for the most cost-effective system?
- System upkeep
  - Will it be difficult to maintain the mitigation system once it is operational?
  - What are the costs associated with this upkeep?
- Remaining building lifetime
  - What is the remaining lifetime of the building?
  - Would it be more cost-effective to construct or lease a new facility?
- Short-term options
  - What are the exposure risks?
  - Can the space usage be modified to decrease the potential radon exposure?
- Scheduled mechanical replacements and upgrades
  - Is the building mechanical system scheduled for replacement within the mitigation time allotted?

- If yes, can the replacement system installation be accelerated and designed to mitigate the problem?

From these considerations, costs, and issues, a primary and secondary mitigation method is selected.

In summary, early indications, based on the buildings examined, are that increased ventilation will be the mitigation solution for well over half of the buildings. This should not be interpreted to mean that other mitigation means should be disqualified. As a general rule, SSD systems cost $800 per suction pit (HFLP) and less than $100 per year to operate. In buildings for which it is well suited, SSD is the most cost-effective long-term solution.

3.9 RECOMMENDATIONS FOR MITIGATION DIAGNOSTICS

Radon mitigation of large buildings will continue to be an evolutionary process for USPS in the foreseeable future. Based on the HAZWRAP diagnostic team's knowledge of USPS buildings, approximately 30 additional buildings (different from the types listed in Table 144) will require study before a comprehensive matrix can be completed. The recommendation is made that mitigation diagnostics and mitigation be centrally managed in order to continue building a knowledge base.

3.10 POSTMITIGATION

The field of postmitigation testing is currently an unknown area because in order for concise recommendations to be made, long-duration studies must be performed to measure mitigation durability and reliability. Because of the lack of research funds during the past 5 years, EPA and DOE have been unable to conduct the in-depth studies needed to compile recommended guidelines. In lieu of this, ORNL has been collecting information from various sources (e.g., private contractors, fellow researchers, and state and federal agencies) and compiling a preliminary data base from which to develop a postmitigation protocol. This data base is not complete and deals only with residential mitigation. However, the existing data should provide a sufficient foundation on which to build an interim protocol. The recommendation is made that USPS maintain a centralized data base to track mitigation method and mitigation failure. If performed, sufficient information for long-term maintenance would be achieved within 5 to 7 years. From this information, a more comprehensive postmitigation plan could then be developed.

3.10.1 Postmitigation Interim Protocol

The postmitigation phase is divided into three distinct parts: verification, documentation, and maintenance. The first step, verification testing, is performed after the mitigation system has been installed and activated. These measurements are short term (2 to 5 days) and are performed solely to verify that mitigation has actually occurred. If mitigation has been achieved (e.g., radon <4 pCi/L), then a second, long-term (90 to 120 days) measurement is performed to verify long-term radon reduction. All testing should be in accordance with the procedures listed in Sect. 1.

If mitigation has been achieved (e.g., 90- to 120-day measurements of <4 pCi/L), then the following information must be collected for future reference:

- mitigation company name,
- specific type of mitigation system,
- specifications and design of system (e.g., drawings, flows, pressures),
- maintenance requirements (e.g., filter changes, damper adjustments),
- installation cost,
- pre- and postmitigation radon levels, and
- Phase II diagnostic data.

The next step, maintenance testing, is a short-term measurement performed at specific time intervals to verify that radon mitigation is still being achieved. The proper interval for the testing is based on the type of mitigation system and the premitigation radon levels. Table 147 lists the testing interval as a function of the mitigation system.

Table 147. Postmitigation testing interval as a function of mitigation system

Mitigation system	Time between sampling (years)[a]
Passive sealing	3 to 5
Passive ventilation	3 to 5
Pressurization	1 to 2
Heat recovery ventilation	2 to 3
Charcoal absorption[b]	1 to 2
Subslab depressurization	3 to 5
Management in place	1 to 2
Mechanical system adjustment	1 to 2

[a]If the premitigation levels were >20 pCi/L, the lower value should be used.
[b]No independent, postmitigation data exist for this type of mitigation system. Estimates are based on conservative assumptions.

Interpretation of the maintenance testing data is as follows:

- If all measurements are <4 pCi/L, then retest at the next interval (Table 147).

- If the retest measurement is >4 pCi/L but <10 pCi/L, then an immediate confirmation test should be performed. If the follow-up measurement is confirmed or if the maintenance measurement is >10 pCi/L, then a mitigation system diagnostic test should be performed.

3.10.2 Mitigation Failure Diagnostics

All radon mitigation systems will eventually fail. Understanding the cause of the failure and tracking the solutions will provide insight for future mitigation system selection and design. Therefore, the need for established mitigation failure diagnostics is just as important as the Phase II diagnostics (Sect. 2).

The first step for mitigation failure diagnostics should be a review of the postmitigation documentation (Sect. 3.10.1). The mitigation system should then be inspected, performance diagnostics performed, and comparisons made to the original documentation and system specifications. During the data review, the key questions to ask are as follows:

- Is the system performing within the original documented parameters?
- Is this a new radon problem or a general system failure?
- Can the existing system be repaired or modified?

Based upon this inspection, one of following events will occur:

- The system will be repaired or modified.
- The system will be replaced.
- An additional system will be installed to supplement the existing system.

After this step, the steps outlined in Sect. 3.10.1 are repeated.

3.10.3 Major Renovation

After any mechanical or structural renovation, radon retesting should be performed. This is particularly important if mitigation was achieved by ventilation. Ideally, for buildings with a history of elevated radon, the testing should be performed as soon as possible after the renovation has been completed. If testing determines that mitigation failure has occurred, then the procedures outlined in Sect. 3.10.2 should be followed. For buildings that have been tested, but were found to be <4 pCi/L, the buildings should be retested in accordance with the potential for elevated radon in that geographic area. The recommended retest due to renovation schedule is outlined in Table 148.

Table 148. Building modification and renovation retest schedule[a]

Radon zone (% >4 pCi/L)	Recommended testing interval (months)[b]
< 1	12
1 to 5	8
5 to 10	6
10 to 20	4
> 20	2
Mitigated building	1

[a] All retesting due to renovation should be short term and conducted in accordance with the procedures outlined in Sect. 1.

[b] Months after renovation has been completed.

REFERENCES

Beir IV, Committee on Biological Effects of Ionizing Radiation, National Research Council., *Health Risks of Radon and Other Internally Deposited Alpha-Emitters*, National Academy Press, Washington, D.C., 1988.

Boyd, M., et al., *Overview of the Federal Radon Testing Program, International Health Physics Conference*, Washington, D.C., 1991.

Environmental Protection Agency, Department of Health and Human Services, and the U.S. Public Health Service, *A Citizen's Guide To Radon*, ANR-464, Second Edition, May 1992.

Hazardous Waste Remedial Actions Program, *Radon Levels and Diagnostics at 38 U.S. Postal Service Sites*, DOE/HWP-140, Martin Marietta Energy Systems, Inc., August 1993.

Hazardous Waste Remedial Actions Program, *U.S. Postal Service Radon Testing Guidebook*, Martin Marietta Energy Systems, Inc., July 1992.

Nero, A., et al., "Distribution of Airborne Radon-222 Concentrations in U.S. Homes," *Science* 243:992-991, 1986.

Wilson, D., et al., *Radon in Nonhousing, WATTec Conference*, Knoxville, Tennessee, 1991.

Wilson, D., et al., *Testing for Radon in the Work Place: The Development of a Protocol, American Industrial Hygiene Association Conference*, Boston, Massachusetts, 1992.

APPENDIX A

RADON TESTING DATA
FOR THE U.S. POSTAL SERVICE SITES

Report Date: 12/13/94

United States Postal Service
Radon Confirmation Summary
Martin Marietta Energy Systems

USPOID	City/State	Location	Room Number	Detector ID#	Confirm Detector	Conf Error	Detector PCIL	Confirm PCIL	Result	Conclusion
CO0523	DENVER, CO		D-16	LE7770	SE2434	0	10.1	4.6	Confirmed	Mitigation
CO0523	DENVER, CO	ROOM OFF OF COMPUTER ROOM		LE8088	SF2321	0	5.7	3.4	Marginal	Further Testing Req
CO0523	DENVER, CO		C-14	LF0042	SE5527	0	13.1	1.1	False Pos	No Further Testing
CO0523	DENVER, CO	WALL 3	180	LF0369	SF9785	0	6.2	5.1	Confirmed	Mitigation
CO0523	DENVER, CO	UNDER THROUGHFARE ACROSS FROM J-6		LF1931	SF9774	0	7.0	1.0	False Pos	No Further Testing
CO0526	DENVER, CO	WALL 3 FILE CABINET	271	LE3306	SE5545	0	5.8	2.9	Marginal	Further Testing Req
CO0526	DENVER, CO	ON N-12		LE7426	SF0164	0	7.3	5.7	Confirmed	Mitigation
CO0526	DENVER, CO	SUPPLY ROOM WALL 1	159	LE8399	SM3180	0	6.3	10.1	Confirmed	Mitigation
CO0526	DENVER, CO	H- 17 ON MF		LE9423	SM3321	0	8.3	0.1	False Pos	No Further Testing
CO0526	DENVER, CO	MENS RESTROOM	237	LF1879	SM3244	0	28.7	0.5	False Pos	No Further Testing
CT0381	STAMFORD, CT	MAINT. SUPPLY RM TOP OF METAL CABINET	176	LD6063	SE2311	0	4.7	0.1	False Pos	No Further Testing
CT0381	STAMFORD, CT	COLUMN P6		LD6117	SG1368	0	4.5	0.0	False Pos	No Further Testing
CT0381	STAMFORD, CT	TOP OF STAMP MACHINE MAIN LOBBY	1ST FLR	LE2549	SF1587	0	4.2	0.5	False Pos	No Further Testing
CT0381	STAMFORD, CT	COLUMN G6		LE8993	SD2622	0	4.0	0.0	False Pos	No Further Testing
CT0381	STAMFORD, CT	UNION OFFICE TOP OF METAL CABINET		LE9068	SD2550	0	4.3	0.3	False Pos	No Further Testing
CT0381	STAMFORD, CT	2ND FLR LEFT OFFICE HANGING FROM CEILING	242	LE9166	SD2588	0	5.3	1.3	False Pos	No Further Testing
CT0381	STAMFORD, CT	REVENUE PROTECTION	129	LF0049	SF0169	0	6.5	0.0	False Pos	No Further Testing
CT0381	STAMFORD, CT	ELETRICAL ROOM TOP OF LOCKERS	170	LF0055	SE2485	0	4.9	0.7	False Pos	No Further Testing
CT0381	STAMFORD, CT	COMPRESSOR ROOM	139A	LF1048	SD2441	0	4.5	0.4	False Pos	No Further Testing
CT0381	STAMFORD, CT	RIGHT SIDE TOP OF METAL CABINET		LF1100	SF0215	0	5.8	1.4	False Pos	No Further Testing
GA0808	ATLANTA, GA	SELF DEVELOPMENT LIBRARY	130	LE3748	SF4849	0	20.6	3.6	Marginal	Further Testing Req
GA0808	ATLANTA, GA	CREDIT UNION BACK OFFICE BREAK ROOM		LE3776	SF9792	0	7.2	1.2	False Pos	No Further Testing
GA0808	ATLANTA, GA	C-16		LF0120	SE2464	0	8.0	1.3	False Pos	No Further Testing
GA0808	ATLANTA, GA	ON GREY CABINET	C-107	LF0834	SE2505	0	16.9	10.2	Confirmed	Mitigation
IA0997	WATERLOO, IA	CARRIER ZONE II		LE8355	SE5552	0	7.3	4.8	Confirmed	Mitigation
IA0997	WATERLOO, IA	ZONE II		LE8676	SF0164	0	13.5	3.4	Marginal	Further Testing Req
IA0997	WATERLOO, IA		128	LE9290	SM2866	0	4.7	3.7	Marginal	Further Testing Req
IL1713	AURORA, IL	RIGHT FRONT INSET HANGING PO BOX	MAIN FLR	LE4252	SM2738	0	5.2	5.3	Confirmed	Mitigation
IL1713	AURORA, IL	WOMENS TOILET #157		LE7593	SM2831	0	7.5	17.5	Confirmed	Mitigation
IL1713	AURORA, IL	TOILET	108	LE9276	SM2768	0	4.2	3.1	Marginal	Further Testing Req
IL1713	AURORA, IL	FRONT RIGHT CENTER	MAIN FLR	LE9880	SM2735	0	5.8	2.9	Marginal	Further Testing Req
IL1537	CHICAGO, IL	RIGHT OF DOOR #182 EMERGENCY LIGHT	PUMP RM	LE6786	SM2765	0	4.0	6.4	Confirmed	Mitigation
IL1537	CHICAGO, IL	RIGHT OF DOOR #182 ON EMERGENCY LIGHT	PUMP RM	SM2765	LE6786	0	6.4	4.0	Confirmed	Mitigation
IL0556	ELMHURST, IL		RT #6	LE3591	SM2899	0	11.1	10.0	Confirmed	Mitigation
IL0556	ELMHURST, IL	AIR HANDLER	B	LE4739	SM2743	0	5.4	1.3	False Pos	No Further Testing
IL0556	ELMHURST, IL	BACK HALL WALL HANGING		LF0530	SM2724	0	4.2	3.4	Marginal	Further Testing Req

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USPOID	City/State	Location	Room Number	Detector ID#	Confirm Detector	Conf Error	Detector PCIL	Confirm PCIL	Result	Conclusion
IL0556	ELMHURST, IL	AH-1	B	LF0902	SM2902	0	6.1	4.7	Confirmed	Mitigation
IL0599	HIGHLAND PARK, IL	ON ROUTE BOX #1		LF1080	SM2742	0	4.1	7.1	Confirmed	Mitigation
IL1780	OAKLAWN, IL	MENSROOM HANGING	154	LE6175	SM2733	0	4.3	0.7	False Pos	No Further Testing
IL0704	SCHAUMBURG, IL		RT #9538	LE3669	SM3337	0	4.5	4.6	Confirmed	Mitigation
IL0704	SCHAUMBURG, IL		RT #9504	LE3674	SM2768	0	4.1	2.4	Marginal	Further Testing Req
IL0704	SCHAUMBURG, IL		RT #9527	LE4193	SM3194	0	4.2	3.7	Marginal	Further Testing Req
IL0737	WHEATON, IL	MENS ROOM BACKROOM		LF1902	SM2705	0	5.3	1.4	False Pos	No Further Testing
IL0737	WHEATON, IL	HANGING	BSMT #1	LF2303	SM2808	0	10.5	3.6	Marginal	Further Testing Req
KY0697	PRESTONBURG, KY	BSMT SOUTHWEST CORNER SUPPLY ROOM		LE8149	SM3196	0	21.7	6.8	Confirmed	Mitigation
KY0697	PRESTONBURG, KY	HANGING FROM LIGHT IN CTR OF WEST LOBBY		LE8514	SM3286	0	7.2	3.8	Marginal	Further Testing Req
KY0697	PRESTONBURG, KY	TOP OF LOCKERS IN WEST BATHROOM		LE8562	SM3337	0	13.9	3.1	Marginal	Further Testing Req
KY0697	PRESTONBURG, KY	HANGING FROM LIGHT IN WEST FURNACE ROOM		LE9255	SM3194	0	7.4	3.2	Marginal	Further Testing Req
MN0910	MINNEAPOLIS, MN	POST 2-12B ON TOP OF GREY CONTROL BOX		LE2586	SM2705	0	4.2	6.3	Confirmed	Mitigation
MN0910	MINNEAPOLIS, MN	POST B-8B HANGING ON POST		LF0930	SM2808	0	4.6	3.8	Marginal	Further Testing Req
MN0909	ST PAUL, MN	ON TOP OF CONTROL BOX IN CORNER	301	LE2600	SF2780	0	11.8	0.8	False Pos	No Further Testing
MN0909	ST PAUL, MN	ON TOP OF FILE CABINET	238A	LE3441	SE5558	0	13.3	2.3	Marginal	Further Testing Req
MN0909	ST PAUL, MN	HANGING FROM POLE	POLE2X-E	LE3776	SF3847	0	4.8	3.0	Marginal	Further Testing Req
MN0909	ST PAUL, MN	HANGING	POLE D-3	LE3807	SH2706	0	5.0	1.4	False Pos	No Further Testing
MN0909	ST PAUL, MN	HANGING FROM BEAM IN CENTER OF ROOM	147	LE6665	SE2318	0	4.8	2.3	Marginal	Further Testing Req
MN0909	ST PAUL, MN	HANGING FROM POLE	POLE2X-A	LF2101	SF9809	0	11.3	0.7	False Pos	No Further Testing
MN1039	ST PAUL, MN	ON LEDGE ABOVE DOOR	B2C	LE2477	SE2434	0	5.4	0.0	False Pos	No Further Testing
MN1039	ST PAUL, MN	HANGING FROM PIPE STICKING OUT	AC ROOM	LE3798	SE6628	0	4.5	1.3	False Pos	No Further Testing
NC0486	WINSTON SALEM, NC	VAULT	151	LE2984	SE5681	0	11.3	15.4	Confirmed	Mitigation
NC0486	WINSTON SALEM, NC	POST MASTERS OFFICE	158	LE4304	SM2765	0	4.1	7.9	Confirmed	Mitigation
NC0486	WINSTON SALEM, NC	MAINTENANCE CUSTOMER SERVICE	154	LE6729	SF9781	0	6.9	0.8	False Pos	No Further Testing
NC0486	WINSTON SALEM, NC	POSTMASTERS SECRETARY	145	LE9803	SE2311	0	4.1	1.0	False Pos	No Further Testing
OH1051	CELINA, OH	REAR KEY ROOM BASE COVER KEY RACK	5	LE7388	SF9914	0	6.6	2.8	Marginal	Further Testing Req
OH1051	CELINA, OH	WOMENS RESTROOM		LE7505	SE5520	0	4.7	5.3	Confirmed	Mitigation
OH1051	CELINA, OH	REAR KEY ROOM BASE FLOOR DRAIN	5	LE7759	SE2297	0	8.2	3.9	Marginal	Further Testing Req
OH1051	CELINA, OH	POSTMASTERS OFFICE CORNER BY FLAG	8	LE9363	SF2321	0	5.9	5.7	Confirmed	Mitigation
OH1369	CINCINNATI, OH	NEAR C-6	SPBS-1	LE4463	SM3363	0	5.2	1.3	False Pos	No Further Testing
OH1369	CINCINNATI, OH	DIAGONAL TO G2 ON METAL PANEL		LE8105	SM2706	0	5.8	17.5	Confirmed	Mitigation
OH1369	CINCINNATI, OH		PSM 4	LE8473	SM2742	0	9.5	6.7	Confirmed	Mitigation
OH1369	CINCINNATI, OH	MAINROOM	POLE E-2	LE8820	SM2711	0	4.8	4.9	Confirmed	Mitigation
OH1369	CINCINNATI, OH	PENTHOUSE 4, GREEN PANEL, MIDDLE OF ROOM		LE9115	SM3333	0	5.8	1.5	False Pos	No Further Testing
OH1369	CINCINNATI, OH	2-11	PSM 2E	LE9541	SM2876	0	5.9	5.9	Confirmed	Mitigation

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OH1369	CINCINNATI, OH	LARGE SQUARE BLOCK AREA		LF1448	SM2865	0	4.7	6.5	Confirmed	Mitigation
OH1369	CINCINNATI, OH	C-3 MAIL CHUTE		LF1669	SM2704	0	4.8	2.9	Marginal	Further Testing Req
OH1381	DAYTON, OH	ACROSS FROM BACK LEFT CORNER		LE2998	SE2485	0	12.9	0.2	False Pos	No Further Testing
OH1381	DAYTON, OH	ON SHELF	414	LE3492	SD2420	0	5.0	0.0	False Pos	No Further Testing
OH1381	DAYTON, OH	ON BOOK SHELF	314	LE3588	SF1587	0	7.5	0.1	False Pos	No Further Testing
OH1381	DAYTON, OH		309	LE3629	SD2588	0	4.1	0.0	False Pos	No Further Testing
OH1381	DAYTON, OH	BACK CORNER TOP OF METAL CABINET		LE6690	SG3041	0	11.2	0.5	False Pos	No Further Testing
OH1381	DAYTON, OH	WEST TUNNEL ON SHELF	TUNNEL	LE7344	SD2623	0	5.0	3.3	Marginal	Further Testing Req
OH1381	DAYTON, OH	WEST TUNNEL TOP OF WALL DIVIDER	TUNNEL	LE7847	SF1566	0	5.1	6.6	Confirmed	Mitigation
OH1381	DAYTON, OH	MAINTENCE RM NEXT TO B-4 ON WALL	MAINTENC	LE8299	SD2550	0	4.3	0.0	False Pos	No Further Testing
OH1381	DAYTON, OH	ACROSS FROM ELEVATOR TOP OF SILVER BOX	W.TUNNEL	LE8752	SD2481	0	5.4	0.1	False Pos	No Further Testing
OH1381	DAYTON, OH	MAIN OFFICE WINDOW (CEILING)		LE8887	SG1368	0	5.9	0.0	False Pos	No Further Testing
OH1381	DAYTON, OH	SAFETY ROOM ON CABINET	405	LE9181	SD2441	0	20.3	0.7	False Pos	No Further Testing
OH1381	DAYTON, OH	NEAR MAIN OFFICE WINDOW ON FILE CABINET		LE9366,	SD2544	0	12.1	0.0	False Pos	No Further Testing
OH1381	DAYTON, OH	GAS ALARM	BIG RM	LE9802	SE5527	0	5.1	1.5	False Pos	No Further Testing
OH1381	DAYTON, OH	TUNNEL WEST POWER BOX TOP RIGHT SIDE	TUNNEL	LE9869	SF3962	0	4.3	4.0	Confirmed	Mitigation
OH1381	DAYTON, OH	DUPLICATE	318	LE9932	SD2636	0	5.9	0.0	False Pos	No Further Testing
OH1381	DAYTON, OH	BOILER RM. OFFICE TOP OF CABINET IN BACK	BOILER	LF0489	SF0169	0	4.7	3.1	Marginal	Further Testing Req
OH1381	DAYTON, OH	DROP OFF AREA EAST TUNNELL		LF0518	SE5522	0	8.8	1.8	False Pos	No Further Testing
OH1381	DAYTON, OH	ON TOP OF TOWEL HOLDER	204	LF0646	SD2622	0	12.9	0.1	False Pos	No Further Testing
OH1381	DAYTON, OH	ACROSS FROM SPRAY PANEL TOP OF CABINET		LF0664	SF0626	0	10.2	0.9	False Pos	No Further Testing
OH1381	DAYTON, OH	ON TOP OF CABINET ACROSS REGISTRY SIGN		LF0675	SF0843	0	10.4	0.2	False Pos	No Further Testing
OH1381	DAYTON, OH	TOP OF CABINET ACROSS FROM BUSINESS MAIL		LF0685	SE2311	0	5.9	0.3	False Pos	No Further Testing
OH1381	DAYTON, OH	TOP OF METAL CABINET	216	LF0757	SF0215	0	8.8	0.0	False Pos	No Further Testing
OK0382	NORMAN, OK	CAGE		LE7812	SM2753	0	4.2	1.8	False Pos	No Further Testing
OK0382	NORMAN, OK		RT6920	LE9559	SF2321	0	4.7	1.0	False Pos	No Further Testing
OK0382	NORMAN, OK	MENS FRONT RESTROOM BOX AREA		LF1190	SE5527	0	4.1	0.2	False Pos	No Further Testing
OK0665	NORMAN, OK		A106	LE2325	SM2842	0	34.0	1.6	False Pos	No Further Testing
OK0665	NORMAN, OK		F143	LE2655	SM2880	0	15.3	31.4	Confirmed	Mitigation
OK0665	NORMAN, OK	PCS	C115	LE3136	SF1587	0	18.0	2.8	Marginal	Further Testing Req
OK0665	NORMAN, OK		C117A	LE3585	SM2864	0	11.4	8.9	Confirmed	Mitigation
OK0665	NORMAN, OK		13YBM	LE8472	SF1533	0	19.4	4.4	Confirmed	Mitigation
OK0665	NORMAN, OK		B102	LE9248	SE2485	0	7.1	7.6	Confirmed	Mitigation
OK0665	NORMAN, OK		D128	LF0472	SF3976	0	11.4	1.4	False Pos	No Further Testing
OK0665	NORMAN, OK		F107	LF0946	SG1368	0	12.5	1.6	False Pos	No Further Testing
OK0666	NORMAN, OK	STORAGE		LE6635	SM3196	0	5.5	0.0	Not Back	

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USPOID	City/State	Location	Room Number	Detector ID#	Confirm Detector	Conf Error	Detector PCIL	Confirm PCIL	Result	Conclusion
OK0666	NORMAN, OK	MEN'S RESTROOM		LE6702	SM2866	0	28.6	0.0	Not Back	
OK0666	NORMAN, OK		1010	LE7511	SE6628	0	9.7	0.0	Not Back	
OK0666	NORMAN, OK	MECHANICAL PLANT		LE7775	SF9794	0	18.3	0.0	Not Back	
OK0666	NORMAN, OK	WOMEN'S LOCKER ROOM		LE8275	SM3351	0	6.7	0.0	Not Back	
OK0666	NORMAN, OK	HUMAN RESOURCES		LE9010	SE9927	0	5.4	0.0	Not Back	
OK0666	NORMAN, OK		1002	LF0514	SE2297	0	10.4	0.0	Not Back	
OK0666	NORMAN, OK	DINING ROOM		LF1572	SM2866	0	8.6	0.0	Not Back	
OK0566	TULSA, OK	TOP OF THERMOSTAT		LE7408	SF0215	0	5.5	3.4	Marginal	Further Testing Req
OK0571	TULSA, OK	STATION MANAGER OFFICE		LE6082	SG1368	0	4.6	0.4	False Pos	No Further Testing
OK0571	TULSA, OK	SUPPLY CLOSET BY VAULT		LE8129	SF1587	0	13.7	1.4	False Pos	No Further Testing
PA0949	BETHLEHEM, PA	RECORD STORAGE ROOM COD BOXERS		LE2288	SM2849	0	4.3	1.9	False Pos	No Further Testing
PA0949	BETHLEHEM, PA	MENSROOM TOWEL RACK		LE7450	SM2840	0	7.4	7.6	Confirmed	Mitigation
PA0949	BETHLEHEM, PA	DISPLAY	LOBBY	LE7573	SM2701	8	4.7	0.0	Lost	
PA0949	BETHLEHEM, PA	MENS LOCKER ROOM		LE7821	SM2898	0	4.5	2.6	Marginal	Further Testing Req
PA0949	BETHLEHEM, PA	WOMENS LOCKER #191-E		LE7880	SE5422	0	5.5	1.9	False Pos	No Further Testing
PA0949	BETHLEHEM, PA	MENSROOM		LE9331	SM2885	0	5.3	0.8	False Pos	No Further Testing
PA0949	BETHLEHEM, PA	TAMMY THOMAS OFFICE		LF1971	SM2901	0	7.8	1.0	False Pos	No Further Testing
PA0951	BETHLEHEM, PA	LARGE FLOOR AREA LADIES ROOM		LE2286	SM3397	0	7.8	3.9	Marginal	Further Testing Req
PA0951	BETHLEHEM, PA	LEFT SIDE OF BUILDING		LE2511	SM3417	0	4.9	11.4	Confirmed	Mitigation
PA0951	BETHLEHEM, PA	TOP OF METAL BOX NEAR BOXES		LE3222	SM3409	0	4.8	3.1	Marginal	Further Testing Req
PA0951	BETHLEHEM, PA	LARGE ROOM ON STORAGE SHELF		LE6377	SM2761	0	4.9	1.6	False Pos	No Further Testing
PA0951	BETHLEHEM, PA	TOP OF VAULT		LE7266	SM3339	0	5.5	8.0	Confirmed	Mitigation
PA0951	BETHLEHEM, PA	STORAGE CLOSET		LE7318	SM3288	0	8.3	16.6	Confirmed	Mitigation
PA0951	BETHLEHEM, PA	LARGE FLOOR AREA ON WINDOW SHELF		LE7452	SM3416	0	9.6	9.6	Confirmed	Mitigation
PA0951	BETHLEHEM, PA	TOP OF METAL CABINET ON LEFTSIDE		LE7497	SM3181	0	5.0	22.3	Confirmed	Mitigation
PA0951	BETHLEHEM, PA	FRONT DESK AREA CUSTOMER COUNTER		LE9997	SM3316	0	5.3	6.6	Confirmed	Mitigation
PA0951	BETHLEHEM, PA	BREAKROOM MICROWAVE TABLE		LF1988	SM2852	0	5.5	12.7	Confirmed	Mitigation
PA0951	BETHLEHEM, PA	FRONT DESK AREA BEHIND XPRESS MAIL		LF2000	SM3280	0	8.9	2.2	Marginal	Further Testing Req
PA0951	BETHLEHEM, PA	MENS BATHROOM		LF2057	SM3389	0	6.5	5.0	Confirmed	Mitigation
PA1031	EASTON, PA	WINDOW	BSMT #10	LE3483	SM2895	0	5.9	43.4	Confirmed	Mitigation
PA1031	EASTON, PA	AREA BESIDE CREDIT UNION		LE7319	SM2707	0	4.8	5.9	Confirmed	Mitigation
PA1031	EASTON, PA	BOILER ROOM SUPPLY AREA		LE7414	SM2866	0	5.9	15.4	Confirmed	Mitigation
PA1031	EASTON, PA	BASEMENT DUMWAITERS BY SUPPLY		LE7984	SM2842	0	5.8	5.4	Confirmed	Mitigation
PA1031	EASTON, PA	SMALL ROOM OFF OF10	10	LE9879	SM2711	0	6.3	4.4	Confirmed	Mitigation
PA1031	EASTON, PA	LOCKER ROOM TOP OF LOCKERS		LF0274	SM2864	0	4.7	4.3	Confirmed	Mitigation
PA1032	EASTON, PA	BULK MAIL FILING CABINET	126	LE6914	SM2731	0	6.4	5.5	Confirmed	Mitigation

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PA2082	LEHIGH VALLEY, PA		H-7	LE1212	SE2318	0	5.4	12.9	Confirmed	Mitigation
PA2082	LEHIGH VALLEY, PA	TOP OF TOOL CABINET	235	LE7034	SF9914	0	24.2	4.0	Confirmed	Mitigation
PA2082	LEHIGH VALLEY, PA	MENS BATHROOM LEFT OF MIRROR	317	LE7833	SM3337	0	14.8	21.2	Confirmed	Mitigation
PA2082	LEHIGH VALLEY, PA	DMS PANEL	314	LF1052	SF4057	0	9.3	9.8	Confirmed	Mitigation
PA2082	LEHIGH VALLEY, PA	ACROSS FROM ROOM 336	241	LF1718	SM2735	0	16.3	20.4	Confirmed	Mitigation
PA2082	LEHIGH VALLEY, PA	LOCKER #143	439	LF1752	SM3194	0	5.2	17.7	Confirmed	Mitigation
PA1774	READING, PA	FLOOR #B: SALT ROOM ON DRAIN PIPE		LE7985	SE1904	0	12.1	6.1	Confirmed	Mitigation
PA1775	READING, PA	RT 1176		LF0815	SM2707	0	4.4	3.2	Marginal	Further Testing Req
PA1776	READING, PA	ON TOP OF BATTERY CHARGER	V-14	LE4269	SF6682	0	4.8	2.4	Marginal	Further Testing Req
PA1776	READING, PA	HALLWAY NEXT TO V-16 ON HEAT CONTROL		LE4436	SF9785	0	4.2	2.0	False Pos	No Further Testing
PA2100	READING, PA	CREDIT UNION	A4	LE4126	SM2753	0	5.8	0.0	Not Back	
PA2100	READING, PA	SUPERVISORS LOCKER ROOM RESTROOM	B-8	LE4325	SE5422	0	11.6	0.0	Not Back	
PA2100	READING, PA	BACK OF WINDOW SERVICE ON CABINET		LE4351	SM2777	0	11.3	0.0	Not Back	
PA2100	READING, PA	MAIN FLOOR ON RT 9		LE9272	SF9255	0	15.8	0.0	Not Back	
PA2100	READING, PA	MAIN FLOOR MAINTENANCE SHOP	B-1	LF0222	SE2461	0	4.4	0.0	Not Back	
TN0034	BETHEL SPRINGS, TN	FLOOR #1: TOP OF FILE CABINET #1 WORKROOM		LF0135	SE5520	0	4.5	7.5	Confirmed	Mitigation
TN0082	CHATTANOOGA, TN	FLOOR #1: WOMENS RESTROOM	MAIN	LE8142	SF6682	0	5.9	4.3	Confirmed	Mitigation
TN0082	CHATTANOOGA, TN	FLOOR #1: WINDOW AREA ON GREEN CABINET	MAIN	LE8169	SM2731	0	6.8	6.4	Confirmed	Mitigation
TN0681	CHATTANOOGA, TN	VAULT SHELF	402	LE7518	SE4590	0	4.1	5.1	Confirmed	Mitigation
TN0681	CHATTANOOGA, TN	MENS ROOM CEILING	211	LE9282	SM2735	0	6.1	2.2	Marginal	Further Testing Req
TN0112	CLINTON, TN	MENS BATHROOM TOWEL RACK		LF0921	SE5526	0	14.7	2.1	Marginal	Further Testing Req
TN0123	COOKEVILLE, TN	ON ROUTE 11		LE2311	SM2705	0	6.0	8.1	Confirmed	Mitigation
TN0123	COOKEVILLE, TN	TRAP DOOR BEHIND CAGE		LE8299	SM2808	0	4.2	5.7	Confirmed	Mitigation
TN0140	CROSSVILLE, TN	MAIN SERVICE WINDOW LOBBY TOP OF DISPLAY		LE3157	SM2880	0	4.4	9.4	Confirmed	Mitigation
TN0140	CROSSVILLE, TN	COPY ROOM		LE7309	SF9794	0	4.0	3.6	Marginal	Further Testing Req
TN0140	CROSSVILLE, TN	MAIN FLOOR MIRRORED CABINET OVER WATER FOUNTAIN		LE7576	SE5545	0	6.6	2.5	Marginal	Further Testing Req
TN0140	CROSSVILLE, TN	WOMENS LOCKER ROOM LKR #52		LF1841	SF1533	0	9.6	2.7	Marginal	Further Testing Req
TN0150	DAYTON, TN	FLOOR #B: BOILER ROOM		LE3675	SE2485	0	4.0	6.4	Confirmed	Mitigation
TN0150	DAYTON, TN	FLOOR #1: STORAGE ROOM		LE4559	SE9927	0	9.3	15.7	Confirmed	Mitigation
TN0150	DAYTON, TN	FLOOR #B: BASEMENT ON TOP OF LOCKERS LEFT		LE8523	SE6628	0	8.3	8.2	Confirmed	Mitigation
TN0150	DAYTON, TN	FLOOR #B: STORAGE ROOM IN BASEMENT		LE8871	SG5093	0	6.9	34.7	Confirmed	Mitigation
TN0234	HARRIMAN, TN	LADIES ROOM LOCKER #22		LE6942	SD2582	0	4.3	1.1	False Pos	No Further Testing
TN0293	KINGSTON, TN	MAIL BOX 301	LE7060	LE7060	SE5681	0	5.8	1.6	False Pos	No Further Testing
TN0299	KNOXVILLE, TN	STORAGE SHELF TOP		LE3265	SM2738	0	8.6	5.0	Confirmed	Mitigation
TN0299	KNOXVILLE, TN	CORNER POLE NEAR LOADING DOCK	MAIN RM	LE4307	SF2780	0	4.0	1.2	False Pos	No Further Testing
TN0301	KNOXVILLE, TN	CENTER POLE NEAR MANAGER DESK	MAIN	LE3263	SE5508	0	5.9	3.6	Marginal	Further Testing Req

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TN0301	KNOXVILLE, TN	NEAR PO BOXES SORTING AREA	MAIN	LE6889	SE2434	0	5.5	1.2	False Pos	No Further Testing
TN0301	KNOXVILLE, TN	BACK WALL NEAR CLOCK	MAIN	LE7529	SG5093	0	5.1	2.0	False Pos	No Further Testing
TN0682	KNOXVILLE, TN	IN BETWEEN K8 AND DOOR 1110		LE2931	SE5552	0	4.1	0.9	False Pos	No Further Testing
TN0682	KNOXVILLE, TN	SUPERVISORS BREAK ROOM		LE3006	SF0164	0	6.1	3.5	Marginal	Further Testing Req
TN0682	KNOXVILLE, TN	SATELLITE BREAKROOM # 3	1162	LE7323	SC9783	0	5.5	0.8	False Pos	No Further Testing
TN0682	KNOXVILLE, TN	ON LIGHT	1210	LE7398	SF3976	0	4.2	1.3	False Pos	No Further Testing
TN0682	KNOXVILLE, TN	NEAR D-12	MAIN	LE7994	SD2423	0	4.3	1.4	False Pos	No Further Testing
TN0682	KNOXVILLE, TN	BATTERY CHARGING ROOM		LE8269	SD2629	0	4.9	0.6	False Pos	No Further Testing
TN0682	KNOXVILLE, TN	ON TOP OF FILE CABINET NEAR MANUAL	POST K11	LE8391	SF9914	0	4.3	0.5	False Pos	No Further Testing
TN0682	KNOXVILLE, TN	LOCKER	1156	LE8394	SD2624	0	4.2	0.6	False Pos	No Further Testing
TN0682	KNOXVILLE, TN	TOP OF LIGHT	1087	LE8972	SD2596	0	9.0	0.6	False Pos	No Further Testing
TN0682	KNOXVILLE, TN	ON WINDOW SHELF IN WINDOW SERVICE AREA		LE9094	SD2610	0	5.5	2.2	Marginal	Further Testing Req
TN0756	KNOXVILLE, TN	MAIN ROOM CENTER PIGEON HOLE BOX		LF0887	SF5120	0	5.1	2.2	Marginal	Further Testing Req
TN0757	KNOXVILLE, TN	LOCKER TOP #1	103	LE9895	SE5441	0	4.4	2.5	Marginal	Further Testing Req
TN0759	KNOXVILLE, TN	STATION 1402	MAIN RM	LE3453	SF4300	0	5.2	1.1	False Pos	No Further Testing
TN0759	KNOXVILLE, TN	MANAGERS ROOM TOP OF DESK	101	LF0941	SG8182	0	5.8	3.0	Marginal	Further Testing Req
TN0330	LEOMA, TN	SWINGROOM ON FLOOR		LE4773	SF1814	0	6.3	0.0	Not Back	
TN0686	MEMPHIS, TN	POLE E-13		LE2344	SM3268	0	7.4	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	ACROSS FROM ROOM 135 TOP OF FILE CABINET		LE2614	SM3180	0	4.5	5.1	Confirmed	Mitigation
TN0686	MEMPHIS, TN	FILE CABINET	2028	LE2631	SM3229	0	7.6	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	POLE E-16		LE2634	SM3363	0	9.2	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	POLE G-5		LE2930	SM3244	0	4.9	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	POLE C-9		LE2948	SM3228	0	4.3	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	WINDOW SILL	207	LE3459	SM3333	0	7.5	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	POLE J-4 I-BEAM AT CAGE		LE3840	SM3351	0	8.1	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	POLE C-10		LE4135	SM3232	0	6.3	0.6	False Pos	No Further Testing
TN0686	MEMPHIS, TN	POLE J-10		LE4187	SM3321	0	4.6	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	CAOT RACK TOP	156	LE6269	SM3393	0	9.3	1.3	False Pos	No Further Testing
TN0686	MEMPHIS, TN	POLE B-7		LE6292	SM3235	0	4.1	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	POLE C-6		LE8053	SM3225	0	4.0	0.3	False Pos	No Further Testing
TN0686	MEMPHIS, TN	TOP OF FILE	142	LE8104	SM3299	0	7.2	0.0	False Pos	No Further Testing
TN0686	MEMPHIS, TN	CONTROL ROOM LEFT SIDE OF ROOM	155	LE8217	SM3215	0	11.2	0.0	False Pos	No Further Testing
TN0692	NASHVILLE, TN	INSIDE LOBBY AREA	327	LE2989	SE5686	0	6.8	1.2	False Pos	No Further Testing
TN0692	NASHVILLE, TN		K4	LE3231	SE0505	0	4.3	0.9	False Pos	No Further Testing
TN0692	NASHVILLE, TN	BOOK SHELF	268	LE3987	SG3009	0	7.1	3.1	Marginal	Further Testing Req
TN0692	NASHVILLE, TN	EAST WALL SOUTH CORNER,CUBBY HOLE		LE4442	SE5580	0	9.2	1.6	False Pos	No Further Testing

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TN0692	NASHVILLE, TN		248	LE7020	SD2442	0	5.0	1.4	False Pos	No Further Testing
TN0692	NASHVILLE, TN	MEN'S TOP OF TOWEL RACK	310	LE7616	SF9774	0	6.4	2.0	False Pos	No Further Testing
TN0692	NASHVILLE, TN		H17	LE7862	SE1281	0	4.7	1.0	False Pos	No Further Testing
TN0692	NASHVILLE, TN	D183 SECURITY LIGHT	DOC	LE7945	SF6075	0	4.1	1.4	False Pos	No Further Testing
TN0692	NASHVILLE, TN		K8	LE8274	SG3921	8	4.0	0.0	Lost	
TN0692	NASHVILLE, TN	TOP OF SHELF	232	LF1572	SE5677	0	4.6	2.7	Marginal	Further Testing Req
TN0692	NASHVILLE, TN	TOP OF METAL SHELF AREA	332	LF1728	SE4704	0	9.5	1.6	False Pos	No Further Testing
TN0520	POWELL, TN	CORNER BIG ROOM BESIDE PO BOXES		LE3235	SE5441	0	22.7	2.0	False Pos	No Further Testing
TN0562	SEVIERVILLE, TN	PARCEL ACCEPTANCE WALL 1	116	LE3594	SF0626	0	5.5	1.5	False Pos	No Further Testing
TN0562	SEVIERVILLE, TN	ELETRICAL ROOM	103	LE6175	SE2297	0	4.2	6.4	Confirmed	Mitigation
TN0562	SEVIERVILLE, TN	CUSTODIAL ROOM	110	LF1613	SM2864	0	21.3	5.7	Confirmed	Mitigation
TX1910	DALLAS, TX	PARTS CAGE TO CABINET		LE2586	SE5552	0	5.7	7.8	Confirmed	Mitigation
TX1910	DALLAS, TX		148	LE3249	SM3268	0	5.5	2.4	Marginal	Further Testing Req
TX1910	DALLAS, TX		240	LE3346	SM3215	0	6.4	1.3	False Pos	No Further Testing
TX1910	DALLAS, TX	POLE A-2		LE3512	SM3299	0	6.3	2.5	Marginal	Further Testing Req
TX1910	DALLAS, TX	POLE F-30 INSPECTORS POLE		LE7313	SM3393	0	16.8	5.4	Confirmed	Mitigation
TX1916	DALLAS, TX		J7	LE3235	SE2434	0	5.4	1.4	False Pos	No Further Testing
TX1916	DALLAS, TX		634C	LE7712	SF9785	0	14.8	3.4	Marginal	Further Testing Req
TX1916	DALLAS, TX		F12	LE9377	SE5520	0	6.9	4.9	Confirmed	Mitigation
TX1916	DALLAS, TX	WOMENS BATHROOM	540D	LF0089	SF9774	0	6.6	0.0	False Pos	No Further Testing
TX1916	DALLAS, TX		722	LF1914	SM2777	0	7.3	3.0	Marginal	Further Testing Req
TX0625	GAINESVILLE, TX	CRAWLSPACE		LD7747	SM3336	0	4.2	23.1	Confirmed	Mitigation
TX0625	GAINESVILLE, TX	CRAWLSPACE		LE6709	SF1814	0	6.2	8.1	Confirmed	Mitigation
TX0625	GAINESVILLE, TX	FLOOR #B:	B32	LE7094	SF0843	0	29.6	2.5	Marginal	Further Testing Req
TX0625	GAINESVILLE, TX	CRAWLSPACE		LE9120	SM2850	0	7.1	13.4	Confirmed	Mitigation
TX0625	GAINESVILLE, TX	CRAWLSPACE		LF0541	SM3279	0	5.8	12.1	Confirmed	Mitigation
TX0625	GAINESVILLE, TX		B24	LF0830	SM2802	0	6.7	4.2	Confirmed	Mitigation

Total Confirmation Detectors Shipped: 243
Total PCIL Values Confirmed: 103
Total Marginal Results: 49

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USPOID	City/State	Total Detectors	Needs Confirmed	Confirmed	False Positive	Conclusion
AL0800	TALLADEGA, AL	33	21	0	0	Needs Confirmation
AR0279	HOPE, AR	16	1	0	0	Needs Confirmation
CA0169	LONG BEACH, CA	76	0	0	0	Testing In Progress
CA0093	LOS ANGELES, CA	636	0	0	0	Testing In Progress
CA2144	SAN DIEGO, CA	104	0	0	0	Testing In Progress
CA3000	SAN DIEGO, CA	288	0	0	0	Testing In Progress
CA2157	SANTA ANA, CA	150	0	0	0	Testing In Progress
CO0141	DENVER, CO	19	0	0	0	No Further Testing
CO0155	DENVER, CO	30	1	0	0	Needs Confirmation
CO0159	DENVER, CO	32	0	0	0	No Further Testing
CO0523	DENVER, CO	143	10	2	3	Mitigate
CO0526	DENVER, CO	226	12	2	3	Mitigate
CT0381	STAMFORD, CT	198	0	0	10	Further Testing Required
CT0360	WILLIMANTIC, CT	30	0	0	0	Testing In Progress
FL0365	KISSIMMEE, FL	24	0	0	0	Testing In Progress
FL0366	KISSIMMEE, FL	30	0	0	0	Testing In Progress
FL0407	OCOEE, FL	30	5	0	0	Needs Confirmation
FL0413	ORLANDO, FL	22	0	0	0	Testing In Progress
FL0416	ORLANDO, FL	20	0	0	0	Testing In Progress
FL0417	ORLANDO, FL	24	0	0	0	Testing In Progress
FL0420	ORLANDO, FL	33	0	0	0	Testing In Progress
FL0421	ORLANDO, FL	30	0	0	0	Testing In Progress
FL0422	ORLANDO, FL	19	0	0	0	Testing In Progress
FL0423	ORLANDO, FL	24	0	0	0	Testing In Progress
FL0424	ORLANDO, FL	36	0	0	0	Testing In Progress
FL0924	ORLANDO, FL	137	0	0	0	Testing In Progress
FL0454	ST CLOUD, FL	36	0	0	0	Testing In Progress
GA0386	AMERICUS, GA	56	19	0	0	Needs Confirmation
GA0806	ATLANTA, GA	143	20	0	0	Needs Confirmation
GA0808	ATLANTA, GA	158	18	1	3	Mitigate
GA0179	FARMINGTON, GA	52	11	0	0	Needs Confirmation
GA0195	GREENSBORO, GA	12	10	0	0	Needs Confirmation
GA0197	GRIFFIN, GA	12	4	0	0	Needs Confirmation
GA0576	LOUISVILLE, GA	11	3	0	0	Needs Confirmation
GA0586	MACON, GA	50	2	0	0	Needs Confirmation
GA0606	MILLEDGEVILLE, GA	30	11	0	0	Needs Confirmation
GA0709	SPARTA, GA	12	1	0	0	Needs Confirmation
GA0361	WINDER, GA	51	32	0	0	Needs Confirmation
GA0767	WRIGHTSVILLE, GA	10	1	0	0	Needs Confirmation
GU0006	AGANA, GU	40	0	0	0	No Further Testing
IA0364	ELDORA, IA	20	15	0	0	Needs Confirmation
IA0624	MASON CITY, IA	32	9	0	0	Needs Confirmation
IA0892	TIPTON, IA	9	1	0	0	Needs Confirmation
IA0997	WATERLOO, IA	88	3	1	2	Mitigate
IL0500	ARLINGTON HEIGH, IL	60	0	0	0	No Further Testing
IL1713	AURORA, IL	118	0	2	2	Mitigate
IL0516	BLOOMINGDALE, IL	31	0	0	0	No Further Testing
IL1537	CHICAGO, IL	5	0	2	0	Mitigate
IL1547	CHICAGO, IL	275	9	0	0	Needs Confirmation
IL0543	DES PLAINES, IL	88	0	0	0	No Further Testing
IL0556	ELMHURST, IL	92	0	2	2	Mitigate
IL0599	HIGHLAND PARK, IL	56	0	1	0	Mitigate
IL0625	LIBERTYVILLE, IL	48	0	0	0	No Further Testing
IL1080	LISLE, IL	65	0	0	0	No Further Testing

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IL1780	OAKLAWN, IL	123	0	0	1	Further Testing Required
IL0704	SCHAUMBURG, IL	47	0	1	2	Mitigate
IL1695	SCHAUMBURG, IL	62	0	0	0	No Further Testing
IL1337	TINLEY PARK, IL	57	0	0	0	No Further Testing
IL0737	WHEATON, IL	39	0	0	2	Further Testing Required
IN0537	MARION, IN	36	16	0	0	Needs Confirmation
KS0152	EMPORIA, KS	33	12	0	0	Needs Confirmation
KS0437	SCOTT CITY, KS	20	12	0	0	Needs Confirmation
KY0010	COVINGTON, KY	52	4	0	0	Needs Confirmation
KY0663	PARIS, KY	28	24	0	0	Needs Confirmation
KY0697	PRESTONBURG, KY	25	5	1	3	Mitigate
LA0292	LAKE PROVIDENCE, LA	7	4	0	0	Needs Confirmation
ME0124	EASTPORT, ME	12	5	0	0	Needs Confirmation
ME0229	MACHIAS, ME	15	12	0	0	Needs Confirmation
ME0488	PORTLAND, ME	150	0	0	0	Testing In Progress
ME0351	ROCKLAND, ME	25	17	0	0	Needs Confirmation
MI0984	BIRMINGHAM, MI	20	0	0	0	No Further Testing
MI1058	ROYAL OAK, MI	48	1	0	0	Needs Confirmation
MN0908	DULUTH, MN	131	0	0	0	Testing In Progress
MN0910	MINNEAPOLIS, MN	488	5	1	1	Mitigate
MN0730	ST PAUL, MN	25	0	0	0	No Further Testing
MN0909	ST PAUL, MN	248	0	0	6	Further Testing Required
MN1039	ST PAUL, MN	229	1	0	2	Needs Confirmation
MO0099	FESTUS, MO	33	3	0	0	Needs Confirmation
MO0104	FLORISSANT, MO	72	4	0	0	Needs Confirmation
MO0161	JEFFERSON CITY, MO	18	5	0	0	Needs Confirmation
MT0089	DILLON, MT	38	16	0	0	Needs Confirmation
NC0671	GASTONIA, NC	29	3	0	0	Needs Confirmation
NC0830	RAEFORD, NC	20	0	0	0	Testing In Progress
NC0417	STATESVILLE, NC	27	0	0	0	No Further Testing
NC0907	WAYNESVILLE, NC	163	66	0	0	Needs Confirmation
NC0483	WINSTON SALEM, NC	59	40	0	0	Needs Confirmation
NC0486	WINSTON SALEM, NC	49	0	2	2	Mitigate
NE0065	BOYS TOWN, NE	4	0	0	0	Testing In Progress
NE0122	CRAWFORD, NE	10	1	0	0	Needs Confirmation
NE0552	LINCOLN, NE	126	0	0	0	Testing In Progress
NE0365	OMAHA, NE	5	0	0	0	Testing In Progress
NE0366	OMAHA, NE	1	0	0	0	Testing In Progress
NE0367	OMAHA, NE	4	0	0	0	Testing In Progress
NE0368	OMAHA, NE	3	0	0	0	Testing In Progress
NE0369	OMAHA, NE	3	0	0	0	Testing In Progress
NE0370	OMAHA, NE	3	0	0	0	Testing In Progress
NE0372	OMAHA, NE	2	0	0	0	Testing In Progress
NE0373	OMAHA, NE	9	0	0	0	Testing In Progress
NE0374	OMAHA, NE	2	0	0	0	Testing In Progress
NE0376	OMAHA, NE	1	0	0	0	Testing In Progress
NE0377	OMAHA, NE	6	0	0	0	Testing In Progress
NE0379	OMAHA, NE	4	0	0	0	Testing In Progress
NE0380	OMAHA, NE	2	0	0	0	Testing In Progress
NE0383	OMAHA, NE	1	0	0	0	Testing In Progress
NE0386	OMAHA, NE	4	0	0	0	Testing In Progress
NE0387	OMAHA, NE	10	0	0	0	Testing In Progress
NE0554	OMAHA, NE	292	0	0	0	No Further Testing
NE0405	PAWNEE CITY, NE	92	0	0	0	No Further Testing

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NJ0580	TRENTON, NJ	204	0	0	0	Testing In Progress
NM0020	ALBUQUERQUE, NM	121	0	0	0	Testing In Progress
NM0089	DEMING, NM	12	0	0	0	Testing In Progress
NM0237	RATON, NM	15	4	0	0	Needs Confirmation
NV0124	RENO, NV	188	0	0	0	Testing In Progress
OH1051	CELINA, OH	22	0	2	2	Mitigate
OH1369	CINCINNATI, OH	476	5	5	3	Mitigate
OH1381	DAYTON, OH	225	1	2	20	Mitigate
OH0195	LANCASTER, OH	35	35	0	0	Needs Confirmation
OH0229	MARYSVILLE, OH	11	10	0	0	Needs Confirmation
OH1348	WAPAKONETA, OH	4	0	0	0	Testing In Progress
OK0206	FREDERICK, OK	10	0	0	0	No Further Testing
OK0231	GUTHRIE, OK	41	0	0	0	No Further Testing
OK0382	NORMAN, OK	31	1	0	3	Needs Confirmation
OK0665	NORMAN, OK	293	33	4	4	Mitigate
OK0666	NORMAN, OK	208	32	7	1	Mitigate
OK0566	TULSA, OK	31	0	0	1	Further Testing Required
OK0568	TULSA, OK	34	0	0	0	No Further Testing
OK0570	TULSA, OK	45	6	0	0	Needs Confirmation
OK0571	TULSA, OK	41	0	0	2	Further Testing Required
OK0688	TULSA, OK	236	22	0	0	Needs Confirmation
PA0949	BETHLEHEM, PA	74	0	1	5	Mitigate
PA0951	BETHLEHEM, PA	12	0	8	4	Mitigate
PA1031	EASTON, PA	99	4	6	0	Mitigate
PA1032	EASTON, PA	49	0	1	0	Mitigate
PA1647	LANCASTER, PA	18	0	0	0	Testing In Progress
PA2081	LANCASTER, PA	207	0	0	0	Testing In Progress
PA2082	LEHIGH VALLEY, PA	299	7	6	0	Mitigate
PA0702	MERCER, PA	18	17	0	0	Needs Confirmation
PA1774	READING, PA	65	9	1	0	Mitigate
PA1775	READING, PA	15	0	0	1	Further Testing Required
PA1776	READING, PA	18	0	0	2	Further Testing Required
PA2100	READING, PA	107	9	2	3	Mitigate
TN0004	ALAMO, TN	6	0	0	0	Testing In Progress
TN0012	ANTIOCH, TN	23	0	0	0	Testing In Progress
TN0015	ARLINGTON, TN	13	0	0	0	Testing In Progress
TN0018	ATHENS, TN	2	0	0	0	Testing In Progress
TN0034	BETHEL SPRINGS, TN	3	0	1	0	Mitigate
TN0042	BLUFF CITY, TN	10	0	0	0	Testing In Progress
TN0044	BOLIVAR, TN	8	0	0	0	Testing In Progress
TN0046	BRADFORD, TN	2	0	0	0	Testing In Progress
TN0048	BRENTWOOD, TN	14	0	0	0	Testing In Progress
TN0051	BROWNSVILLE, TN	9	0	0	0	Testing In Progress
TN0067	CAMDEN, TN	11	0	0	0	Testing In Progress
TN0069	CARTHAGE, TN	5	0	0	0	Testing In Progress
TN0077	CHAPMANSBORO, TN	2	0	0	0	Testing In Progress
TN0079	CHARLOTTE, TN	3	0	0	0	Testing In Progress
TN0080	CHATTANOOGA, TN	16	0	0	0	No Further Testing
TN0081	CHATTANOOGA, TN	5	0	0	0	Testing In Progress
TN0082	CHATTANOOGA, TN	15	0	2	0	Mitigate
TN0083	CHATTANOOGA, TN	17	0	0	0	Testing In Progress
TN0681	CHATTANOOGA, TN	137	0	1	1	Mitigate
TN0107	CLEVELAND, TN	23	1	0	0	Needs Confirmation
TN0112	CLINTON, TN	21	0	0	1	Further Testing Required

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USPOID	City/State	Total Detectors	Needs Confirmed	Confirmed	False Positive	Conclusion
TN0118	COLLIERVILLE, TN	23	0	0	0	Testing In Progress
TN0120	COLUMBIA, TN	19	0	0	0	Testing In Progress
TN0123	COOKEVILLE, TN	55	1	2	0	Mitigate
TN0124	COOKEVILLE, TN	15	1	0	0	Needs Confirmation
TN0127	CORDOVA, TN	19	0	0	0	Testing In Progress
TN0134	COVINGTON, TN	11	0	0	0	No Further Testing
TN0140	CROSSVILLE, TN	46	2	1	3	Mitigate
TN0148	DANDRIDGE, TN	6	0	0	0	No Further Testing
TN0150	DAYTON, TN	19	2	4	0	Mitigate
TN0153	DECHERD, TN	5	0	0	0	No Further Testing
TN0164	DRESDEN, TN	8	0	0	0	Testing In Progress
TN0171	DYERSBURG, TN	15	0	0	0	Testing In Progress
TN0179	ELIZABETHTON, TN	23	0	0	0	Testing In Progress
TN0187	ERWIN, TN	10	9	0	0	Needs Confirmation
TN0196	FAYETTEVILLE, TN	19	0	0	0	No Further Testing
TN0204	FRANKLIN, TN	25	0	0	0	No Further Testing
TN0210	GALLATIN, TN	15	0	0	0	Testing In Progress
TN0217	GLEASON, TN	7	0	0	0	Confirmation In Progress
TN0224	GREENBRIER, TN	2	0	0	0	Testing In Progress
TN0225	GREENEVILLE, TN	16	0	0	0	Testing In Progress
TN0226	GREENFIELD, TN	3	0	0	0	Testing In Progress
TN0234	HARRIMAN, TN	8	0	0	1	Further Testing Required
TN0243	HENDERSONVILLE, TN	12	0	0	0	Testing In Progress
TN0246	HERMITAGE, TN	14	0	0	0	Testing In Progress
TN0251	HIXSON, TN	11	0	0	0	Testing In Progress
TN0256	HORNSBY, TN	1	0	0	0	Testing In Progress
TN0257	HUMBOLDT, TN	14	0	0	0	No Further Testing
TN0258	HUNTINGDON, TN	8	0	0	0	No Further Testing
TN0260	HUNTSVILLE, TN	8	0	0	0	No Further Testing
TN0265	JACKSBORO, TN	3	0	0	0	Testing In Progress
TN0267	JACKSON, TN	21	0	0	0	Testing In Progress
TN0275	JEFFERSON CITY, TN	12	11	0	0	Needs Confirmation
TN0277	JELLICO, TN	12	9	0	0	Needs Confirmation
TN0282	JOHNSON CITY, TN	70	39	0	0	Needs Confirmation
TN0287	KINGSPORT, TN	56	5	0	0	Needs Confirmation
TN0293	KINGSTON, TN	8	0	0	1	Further Testing Required
TN0296	KNOXVILLE, TN	19	3	0	0	Needs Confirmation
TN0299	KNOXVILLE, TN	18	0	1	1	Mitigate
TN0301	KNOXVILLE, TN	23	0	0	3	Further Testing Required
TN0310	KNOXVILLE, TN	90	17	0	0	Needs Confirmation
TN0682	KNOXVILLE, TN	242	0	0	10	Further Testing Required
TN0756	KNOXVILLE, TN	23	0	0	1	Further Testing Required
TN0757	KNOXVILLE, TN	19	1	0	1	Needs Confirmation
TN0759	KNOXVILLE, TN	23	0	0	2	Further Testing Required
TN0314	LAFAYETTE, TN	16	9	0	0	Needs Confirmation
TN0000	LAKE CITY, TN	12	0	0	0	No Further Testing
TN0324	LAWRENCEBURG, TN	15	0	0	0	Testing In Progress
TN0328	LENOIR CITY, TN	10	10	0	0	Needs Confirmation
TN0330	LEOMA, TN	2	0	1	0	Mitigate
TN0331	LEWISBURG, TN	11	0	0	0	No Further Testing
TN0332	LEXINGTON, TN	9	0	0	0	Testing In Progress
TN0336	LIVINGSTON, TN	9	0	0	0	No Further Testing
TN0340	LOUDON, TN	8	4	0	0	Needs Confirmation
TN0355	MADISON, TN	10	0	0	0	Testing In Progress

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USPOID	City/State	Total Detectors	Needs Confirmed	Confirmed	False Positive	Conclusion
TN0351	MCKENZIE, TN	15	0	0	0	Testing In Progress
TN0353	MCMINNVILLE, TN	1	0	0	0	Testing In Progress
TN0686	MEMPHIS, TN	299	0	1	14	Mitigate
TN0688	MEMPHIS, TN	327	12	0	0	Needs Confirmation
TN0427	MORRISTOWN, TN	10	9	0	0	Needs Confirmation
TN0692	NASHVILLE, TN	238	1	0	10	Needs Confirmation
TN0483	OAK RIDGE, TN	18	0	0	0	No Further Testing
TN0484	OAK RIDGE, TN	250	0	0	0	Testing In Progress
TN9999	OAK RIDGE, TN	28	0	0	0	No Further Testing
TN0491	ONEIDA, TN	17	7	0	0	Needs Confirmation
TN0520	POWELL, TN	25	0	0	1	Further Testing Required
TN0543	ROCKWOOD, TN	10	5	0	0	Needs Confirmation
TN0544	ROGERSVILLE, TN	10	7	0	0	Needs Confirmation
TN0562	SEVIERVILLE, TN	27	2	2	1	Mitigate
TN0579	SODDY DAISY, TN	10	0	0	0	No Further Testing
TN0605	SWEETWATER, TN	7	7	0	0	Needs Confirmation
TN0636	WARTBURG, TN	7	0	0	0	No Further Testing
TX1903	ABILENE, TX	49	1	0	0	Needs Confirmation
TX0080	DALLAS, TX	47	18	0	0	Needs Confirmation
TX1910	DALLAS, TX	291	18	2	3	Mitigate
TX1916	DALLAS, TX	435	37	1	4	Mitigate
TX0625	GAINESVILLE, TX	48	3	5	1	Mitigate
TX0317	PARIS, TX	32	8	0	0	Needs Confirmation
TX1671	PECOS, TX	18	0	0	0	No Further Testing
TX1865	WACO, TX	86	0	0	0	Testing In Progress
UT0066	HEBER CITY, UT	9	5	0	0	Needs Confirmation
UT0204	TOOELE, UT	18	5	0	0	Needs Confirmation
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	Totals:	14201	939	87	154	

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AL0800	MAIN OFFICE	EAST ST N OF E COOSA	TALLADEGA, AL	33	4	2	27	0	27	13.8	MITIGATION
AR0279	MAIN OFFICE	121 S LAUREL ST	HOPE, AR	16	0	15	1	0	1	5.2	
CA0169	MAIN OFFICE	300 LONG BEACH BLVD	LONG BEACH, CA	76	0	0	0	0	0		
CA0093	GMF/VMF/MAIN OFFICE	7001 S. CENTRAL AVE.	LOS ANGELES, CA	636	0	0	0	0	0	0.0	
CA2144	PROCESSING & DIST CT	2535 MIDWAY DRIVE	SAN DIEGO, CA	104	0	0	0	0	0	0.0	
CA3000	P & D CENTER	RANCHO CARMEL ROAD	SAN DIEGO, CA	288	0	0	0	0	0	0.0	
CA2157	GMF	3101 WEST SUNFLOWER	SANTA ANA, CA	150	0	0	0	0	0	0.0	
CO0141	WELLSHIRE STATION	2080 SOUTH HOLLY	DENVER, CO	19	0	19	0	0	0	2.4	
CO0155	MONTCLAIR	8275 E 11TH	DENVER, CO	30	0	29	1	0	1	4.0	
CO0159	DOWNTOWN	951 TWENTIETH STREET	DENVER, CO	32	0	32	0	0	0	3.3	
CO0523	BULK MAIL CENTER	7755 EAST 56TH AVE.	DENVER, CO	143	4	124	14	1	15	22.4	
CO0526	GMF	7500 E 53RD PL	DENVER, CO	226	11	198	16	1	17	28.7	
CT0381	GMF	427 WEST AVENUE	STAMFORD, CT	198	11	188	10	0	10	6.5	
CT0360	MAIN OFFICE	919 MAIN ST	WILLIMANTIC, CT	30	30	0	0	0	0	0.0	
FL0365	OAK STREET STATION	1415 W OAK ST	KISSIMMEE, FL	24	0	0	0	0	0		
FL0366	MAIN OFFICE	2600 MICHIGAN AVE	KISSIMMEE, FL	30	0	0	0	0	0		
FL0407	MAIN OFFICE	449 W SILVER STAR RD	OCOEE, FL	30	0	7	4	1	5	49.7	
FL0413	DOWNTOWN STATION	46 EAST ROBINSON ST	ORLANDO, FL	22	0	0	0	0	0		
FL0416	DIXIE VILLAGE STATIO	2860 DELANEY AVENUE	ORLANDO, FL	20	0	0	0	0	0		
FL0417	PINE CASTLE BRANCH	7707 SOUTH ORANGE AVE	ORLANDO, FL	24	0	0	0	0	0		
FL0420	HIAWASSEE BRANCH	3200 N HIAWASSEE RD	ORLANDO, FL	33	0	0	0	0	0		
FL0421	SAND LAKE BRANCH	10450 SO TURKEY LAKE	ORLANDO, FL	30	0	0	0	0	0	0.0	
FL0422	AUXILIARY VMF	10401 TRADEPORT DR	ORLANDO, FL	19	0	0	0	0	0		
FL0423	ORLO VISTA BRANCH	501 SO KIRKMAN RD	ORLANDO, FL	24	0	0	0	0	0		
FL0424	ALAFAYA ANNEX		ORLANDO, FL	36	0	0	0	0	0	0.0	
FL0924	GMF	10401 TRADEPORT DR	ORLANDO, FL	137	0	0	0	0	0	0.0	
FL0454	MAIN OFFICE	301 S KISSIMMEE PARK	ST CLOUD, FL	36	0	0	0	0	0	0.0	
GA0386	MAIN OFFICE	128 E FORSYTH ST	AMERICUS, GA	56	0	36	18	1	19	26.8	
GA0806	BULK MAIL CENTER	1800 JAMES JACKSON PK	ATLANTA, GA	143	7	105	28	2	30	40.1	
GA0808	GMF	3900 CROWN RD	ATLANTA, GA	158	17	120	21	1	22	20.6	
GA0179	MAIN OFFICE	HIGHWAY 441/MAIN STRE	FARMINGTON, GA	52	0	31	11	0	11	13.1	
GA0195	MAIN OFFICE	115 MAIN ST SO	GREENSBORO, GA	12	0	1	10	0	10	12.7	
GA0197	GMF	101 NORTH EIGHT ST	GRIFFIN, GA	12	0	8	4	0	4	5.8	
GA0576	MAIN OFFICE	131 W BROAD ST	LOUISVILLE, GA	11	0	7	3	0	3	5.2	

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GA0586	VMF	451 COLLEGE ST	MACON, GA	50	0	41	2	0	2	11.1	
GA0606	MAIN OFFICE	118 E HANCOCK STREET	MILLEDGEVILLE, GA	30	0	18	11	0	11	11.4	
GA0709	MAIN OFFICE	323 E BROAD ST	SPARTA, GA	12	0	6	1	0	1	10.4	
GA0361	MAIN OFFICE	120 N. BROAD ST.	WINDER, GA	51	3	18	32	0	32	19.4	
GA0767	MAIN OFFICE	151 SOUTH MARCUS ST	WRIGHTSVILLE, GA	10	0	8	1	0	1	5.0	
GU0006	MAIN OFFICE	RT 16 & FURY RD	AGANA, GU	40	0	34	5	1	6	22.8	NOT RETURNED AS OF 11/11/94
IA0364	MAIN OFFICE	1334 EDGINGTON AVE	ELDORA, IA	20	0	3	14	1	15	87.4	
IA0624	MAIN OFFICE	211 N DELEWARE	MASON CITY, IA	32	0	23	6	3	9	44.0	
IA0892	MAIN OFFICE	512 LYNN ST	TIPTON, IA	9	1	7	1	0	1	5.4	
IA0997	GMF	300 SYCAMORE AVE	WATERLOO, IA	88	0	68	6	0	6	14.0	
IL0500	MAIN OFFICE	909 W EUCLID ST	ARLINGTON HEIGH, IL	60	1	60	0	0	0	1.8	
IL1713	MAIN OFFICE	525 NORTH BROADWAY	AURORA, IL	118	7	114	4	0	4	7.5	
IL0516	MAIN OFFICE	108 SCHICK RD	BLOOMINGDALE, IL	31	4	31	0	0	0	2.6	
IL1537	MAIN OFFICE	433 W. VAN BUREN	CHICAGO, IL	5	0	3	2	0	2	6.4	
IL1547	BULK MAIL CENTER	7500 W ROOSEVELT RD	CHICAGO, IL	275	28	261	9	0	9	19.9	
IL0543	MAIN OFFICE	1000 OAKTON ST	DES PLAINES, IL	88	3	87	0	0	0	2.2	
IL0556	MAIN OFFICE	154 W PARK AVE	ELMHURST, IL	92	4	88	4	0	4	11.1	
IL0599	MAIN OFFICE	833 CENTRAL AVE	HIGHLAND PARK, IL	56	5	50	1	0	1	4.1	
IL0625	MAIN OFFICE	135 W CHURCH ST	LIBERTYVILLE, IL	48	1	48	0	0	0	3.4	
IL1080	MAIN OFFICE	817 OGDEN AVE	LISLE, IL	65	2	65	0	0	0	3.0	
IL1780	MORAINE VALLEY	7401 W 100TH PLACE	OAKLAWN, IL	123	1	120	1	0	1	4.3	
IL0704	HOFFMAN EST BR	1201 GANNON DRIVE	SCHAUMBURG, IL	47	0	44	3	0	3	4.5	
IL1695	MAIN OFFICE	SCHAUMBURG RD	SCHAUMBURG, IL	62	4	62	0	0	0	3.1	
IL1337	MAIN OFFICE	7230 W 171ST ST	TINLEY PARK, IL	57	2	56	0	0	0	3.6	
IL0737	MAIN OFFICE	122 N WHEATON AVE	WHEATON, IL	39	2	37	2	0	2	10.5	
IN0537	MAIN OFFICE	202 W. THIRD STREET	MARION, IN	36	0	16	15	1	16	20.8	
KS0152	MAIN OFFICE	625 MERCHANT STR	EMPORIA, KS	33	1	20	12	0	12	13.3	
KS0437	MAIN OFFICE	211 MAIN ST	SCOTT CITY, KS	20	0	7	12	0	12	12.2	
KY0010	MAIN OFFICE	700 SCOTT STREET	COVINGTON, KY	52	0	45	4	0	4	6.8	
KY0663	MAIN OFFICE	201 WEST 8TH ST	PARIS, KY	28	0	1	24	0	24	9.2	
KY0697	MAIN OFFICE	COR FIRST ST & 3RD AV	PRESTONBURG, KY	25	1	16	8	1	9	21.7	
LA0292	MAIN OFFICE	202 SPARROW ST	LAKE PROVIDENCE, LA	7	0	3	4	0	4	6.2	
ME0124	MAIN OFFICE	1 WASHINGTON ST	EASTPORT, ME	12	2	4	6	0	6	14.9	
ME0229	MAIN OFFICE	49 COURT ST	MACHIAS, ME	15	1	2	12	0	12	14.3	

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ME0488	MAIN OFFICE	125 FOREST AVENUE	PORTLAND, ME	150	0	0	0	0	0	0.0	NO PLACEMENT SHEETS RECIEVED
ME0351	MAIN OFFICE	21 LIMEROCK ST	ROCKLAND, ME	25	0	8	17	0	17	10.7	
MI0984	MAIN OFFICE	320 MARTIN ST	BIRMINGHAM, MI	20	0	19	1	0	1	4.5	
MI1058	MAIN OFFICE	200 W SECOND ST	ROYAL OAK, MI	48	0	46	1	0	1	13.8	
MN0908	MAIN OFFICE/VMF	2800 W MICHIGAN ST	DULUTH, MN	131	0	0	0	0	0	0.0	NO PLACEMENT SHEETS RECIEVED
MN0910	MAIN OFFICE/OLD VMF	100 SO 1ST STREET	MINNEAPOLIS, MN	488	38	479	7	0	7	8.6	
MN0730	EAGAN BRANCH	2970 SO LEXINGTON	ST PAUL, MN	25	0	25	0	0	0	1.9	
MN0909	BULK MAIL CENTER	3165 S LEXINGTON AVE	ST PAUL, MN	248	7	237	6	0	6	13.3	
MN1039	MAIN OFFICE/ GMF	180 E KELLOGG BLVD	ST PAUL, MN	229	21	224	3	0	3	8.7	
MO0099	MAIN OFFICE	109 WEST MAIN STREET	FESTUS, MO	33	0	22	2	1	3	24.4	
MO0104	CARR STATION	1650 SHACKELFORD RD	FLORISSANT, MO	72	0	59	4	0	4	7.9	
MO0161	MAIN OFFICE	131 WEST HIGH STREET	JEFFERSON CITY, MO	18	0	13	5	0	5	16.5	
MT0089	MAIN OFFICE	117 SO. IDAHO STREET	DILLON, MT	38	3	22	16	0	16	11.2	
NC0671	MAIN OFFICE	301 W MAIN AVE	GASTONIA, NC	29	4	23	3	0	3	10.0	
NC0830	MAIN OFFICE	122 ELWOOD AVE	RAEFORD, NC	20	20	0	0	0	0	0.0	
NC0417	MAIN OFFICE	200 WEST BROAD ST	STATESVILLE, NC	27	8	19	0	0	0	0.0	
NC0907	MAIN OFFICE	205 SO HAYWOOD ST	WAYNESVILLE, NC	163	0	45	60	6	66	78.0	
NC0483	MAIN OFFICE (OLD)	101 WEST FIFTH STREET	WINSTON SALEM, NC	59	4	15	36	4	40	37.8	
NC0486	MAIN OFFICE	1500 NORTH PATTERSON	WINSTON SALEM, NC	49	1	44	4	0	4	11.3	
NE0065	MAIN OFFICE	139 S. 144TH STREET	BOYS TOWN, NE	4	0	0	0	0	0	0.0	
NE0122	MAIN OFFICE	144 MAIN STREET	CRAWFORD, NE	10	2	8	1	0	1	4.2	
NE0552	MAIN OFFICE	700 R STREET	LINCOLN, NE	126	0	0	0	0	0	0.0	NO PLACEMENT SHEETS RECIEVED
NE0365	SOUTH STATION	4730 SOUTH 24TH STREE	OMAHA, NE	5	0	0	0	0	0	0.0	
NE0366	OFFUTT AFB BR.	HIGHWAYS 73 AND 75	OMAHA, NE	1	0	0	0	0	0	0.0	
NE0367	AMES AVENUE	31ST & MEREDITH	OMAHA, NE	4	0	0	0	0	0	0.0	
NE0368	MILLARD BRANCH	4433 S 133RD ST	OMAHA, NE	3	0	0	0	0	0	0.0	
NE0369	PAPILLION BR	ADAMS HY 85 & CENTENI	OMAHA, NE	3	0	0	0	0	0	0.0	
NE0370	SADDLE CREEK STATION	608 N SADDLE CREEK RD	OMAHA, NE	3	0	0	0	0	0	0.0	
NE0372	RALSTON BRANCH	7300 MAIN STREET	OMAHA, NE	2	0	0	0	0	0	0.0	
NE0373	BENSON STATION PRKNG	6223 MAPLE	OMAHA, NE	9	0	0	0	0	0	0.0	
NE0374	STATION B	3021 LEAVENWORTH ST	OMAHA, NE	2	0	0	0	0	0	0.0	
NE0376	FLORENCE STATION	2910 STATE ST	OMAHA, NE	1	0	0	0	0	0	0.0	
NE0377	NORTHWEST ST	NEC 91ST & FORT	OMAHA, NE	6	0	0	0	0	0	0.0	
NE0379	WEST OMAHA STATION	8451 W. CENTER ROAD	OMAHA, NE	4	0	0	0	0	0	0.0	

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NE0380	STATION C	1618 VINTON	OMAHA, NE	2	0	0	0	0	0	0.0	
NE0383	STATION "A"	SEC OF 24TH & GRANT S	OMAHA, NE	1	0	0	0	0	0	0.0	
NE0386	ELMWOOD PARK STN PKG	5116 WALNUT ST	OMAHA, NE	4	0	0	0	0	0	0.0	
NE0387	AIR MAIL FACILITY	EPPLEY AIR FIELD	OMAHA, NE	10	0	0	0	0	0	0.0	
NE0554	MAIN OFFICE	1124 PACIFIC	OMAHA, NE	292	0	1	0	0	0	3.3	
NE0405	MAIN OFFICE	SEVENTH & "G" STREETS	PAWNEE CITY, NE	92	0	5	0	0	0	3.7	
NJ0580	VMF	KLOCKNER RD AT RTE 13	TRENTON, NJ	204	0	0	0	0	0	0.0	NO PLACEMENT SHEETS RECIEVED
NM0020	SPRINGER WAREHOUSE	1517 BROADWAY NE	ALBUQUERQUE, NM	121	121	0	0	0	0	0.0	DETECTORS NEVER RECIEVED
NM0089	MAIN OFFICE	201 WEST SPRUCE	DEMING, NM	12	0	0	0	0	0	0.0	
NM0237	MAIN OFFICE	THIRD ST & PARK AVE	RATON, NM	15	0	10	4	0	4	9.5	
NV0124	GMF/VMF	S/S VASSAR STREET	RENO, NV	188	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
OH1051	MAIN OFFICE	201 N MAIN ST	CELINA, OH	22	0	17	4	0	4	8.2	
OH1369	BULK MAIL CENTER	3055 CRESCENTVILLE RO	CINCINNATI, OH	476	58	404	13	0	13	9.5	
OH1381	MAIN OFFICE	1111 E. FIFTH ST	DAYTON, OH	225	31	191	22	1	23	20.3	
OH0195	MAIN OFFICE	204 S BROAD ST	LANCASTER, OH	35	0	0	31	4	35	54.7	
OH0229	MAIN OFFICE	202 NORTH MAIN STREET	MARYSVILLE, OH	11	0	1	10	0	10	18.6	
OH1348	MAIN OFFICE	12 WILLIPIE	WAPAKONETA, OH	4	0	0	0	0	0	0.0	
OK0206	MAIN OFFICE	120 EAST GRAND AVE	FREDERICK, OK	10	0	10	0	0	0	3.1	
OK0231	MAIN OFFICE	200 WEST OKLAHOMA AVE	GUTHRIE, OK	41	0	40	0	0	0	0.0	
OK0382	SOONER STATION	200 NW 36 ST	NORMAN, OK	31	0	27	4	0	4	7.3	
OK0665	TECH TRNG CTR	2701 E IMHOFF	NORMAN, OK	293	4	247	40	1	41	34.0	
OK0666	STUDENT HOUSING	2801 STATE HWY 9 EAST	NORMAN, OK	208	3	163	37	3	40	36.3	
OK0566	SHERIDAN STATION	6100 E 51ST PL	TULSA, OK	31	0	28	1	0	1	5.5	
OK0568	NORTHEAST STATION	5313 EAST INDEPENDENC	TULSA, OK	34	0	34	0	0	0	3.9	
OK0570	SOUTHEAST STATION	9023 EAST 46TH STREET	TULSA, OK	45	0	38	6	0	6	7.5	
OK0571	EASTSIDE STATION	2920 S 129TH E AVE	TULSA, OK	41	0	39	2	0	2	13.7	
OK0688	P & D CENTER	333 WEST 4TH ST	TULSA, OK	236	0	213	22	0	22	18.5	
PA0949	MAIN OFFICE	535 WOOD STREET	BETHLEHEM, PA	74	3	66	7	0	7	7.8	
PA0951	BUTZTOWN BRANCH	E/S WILLIAM PENN HGWY	BETHLEHEM, PA	12	0	0	12	0	12	9.6	
PA1031	MAIN OFFICE	2ND & FERRY STS	EASTON, PA	99	15	84	10	0	10	6.3	
PA1032	PALMER BRANCH	650 S. GREENWOOD AVE.	EASTON, PA	49	2	48	1	0	1	6.4	
PA1647	VMF	OLD HARRISBURG PIKE	LANCASTER, PA	18	0	0	0	0	0	0.0	
PA2081	GMF	1400 OLD HARRISBURG P	LANCASTER, PA	207	0	0	0	0	0	0.0	
PA2082	GMF & VMF	17 SOUTH COMMERCE WAY	LEHIGH VALLEY, PA	299	18	268	12	1	13	24.2	

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PA0702	MAIN OFFICE	N PITT & E VENANGO ST	MERCER, PA	18	1	0	5	12	17	58.2	
PA1774	DOWNTOWN STATION	59 NORTH FIFTH ST	READING, PA	65	0	55	9	1	10	20.0	
PA1775	WYOMISSING BRANCH	PENN AV & BERN RD	READING, PA	15	0	14	1	0	1	4.4	
PA1776	VMF	2100 NORTH 13TH STREE	READING, PA	18	0	16	2	0	2	4.8	
PA2100	GENERAL MAIL FACILIT	2100 NORTH 13TH STREE	READING, PA	107	6	87	14	0	14	15.8	
TN0004	MAIN OFFICE	146 E PARK STREET	ALAMO, TN	6	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RETRIEVED
TN0012	MAIN OFFICE	BELL FORGE ROAD	ANTIOCH, TN	23	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0015	MAIN OFFICE	AIRLINE RD	ARLINGTON, TN	13	0	0	0	0	0	0.0	
TN0018	MAIN OFFICE	202 S WHITE ST	ATHENS, TN	2	0	0	0	0	0	0.0	
TN0034	MAIN OFFICE	HWY 45 & COLLEGE ST	BETHEL SPRINGS, TN	3	1	1	1	0	1	4.5	
TN0042	MAIN OFFICE	908 JOHNSON CITY HWY	BLUFF CITY, TN	10	0	0	0	0	0	0.0	
TN0044	MAIN OFFICE	118 E MARKET ST	BOLIVAR, TN	8	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0046	MAIN OFFICE	MAIN ST	BRADFORD, TN	2	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0048	MAIN OFFICE	SWC FIRERSON ST/BROOK	BRENTWOOD, TN	14	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0051	MAIN OFFICE	201 ANDERSON AVENUE	BROWNSVILLE, TN	9	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0067	MAIN OFFICE	81 FORREST AVE	CAMDEN, TN	11	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0069	MAIN OFFICE	MAIN ST & 2ND AVE	CARTHAGE, TN	5	0	0	0	0	0	0.0	
TN0077	MAIN OFFICE	HWY 12	CHAPMANSBORO, TN	2	0	0	0	0	0	0.0	
TN0079	MAIN OFFICE	TN 49 & 48	CHARLOTTE, TN	3	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0080	RED BANK BRANCH	2317 DAYTON BLVD	CHATTANOOGA, TN	16	0	16	0	0	0	3.9	
TN0081	SOUTH STATION	1101 W 40TH STREET	CHATTANOOGA, TN	5	0	0	0	0	0	0.0	
TN0082	DOWNTOWN STATION	9TH & GEORGIA AVE.	CHATTANOOGA, TN	15	0	13	2	0	2	6.8	
TN0083	EAST RIDGE BRANCH	1510 MAXWELL RD	CHATTANOOGA, TN	17	0	0	0	0	0	0.0	
TN0681	GMF	6050 SHALLOWFORD RD	CHATTANOOGA, TN	137	6	129	2	0	2	6.1	
TN0107	MAIN OFFICE	1981 KEITH STREET	CLEVELAND, TN	23	0	21	1	0	1	4.6	
TN0112	MAIN OFFICE	1121 CHAS D SEIVERS B	CLINTON, TN	21	1	20	1	0	1	14.7	
TN0118	MAIN OFFICE	131 CENTER ST	COLLIERVILLE, TN	23	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0120	MAIN OFFICE	417W SEVENTH	COLUMBIA, TN	19	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0123	MAIN OFFICE	SOUTH WILLOW AVENUE	COOKEVILLE, TN	55	0	52	3	0	3	6.0	
TN0124	BROAD ST STA	9 E BROAD ST	COOKEVILLE, TN	15	0	14	1	0	1	6.3	
TN0127	MAIN OFFICE	8255 MACON RD	CORDOVA, TN	19	0	0	0	0	0	0.0	
TN0134	MAIN OFFICE	220 S MAIN ST	COVINGTON, TN	11	0	9	1	0	1	4.4	PLACEMENT SHEETS NOT RECIEVED
TN0140	MAIN OFFICE	2020 YORK HWY	CROSSVILLE, TN	46	0	39	6	0	6	9.6	
TN0148	MAIN OFFICE	33 ACADEMY CIRCLE	DANDRIDGE, TN	6	0	6	0	0	0	2.0	PLACEMENT SHEETS NOT RECIEVED

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TN0150	MAIN OFFICE	136 W MAIN AVE	DAYTON, TN	19	0	13	6	0	6	9.3	
TN0153	MAIN OFFICE	MAIN & DIAGONAL ST	DECHERD, TN	5	0	4	1	0	1	6.6	PLACEMENT SHEETS NOT RECIEVED
TN0164	MAIN OFFICE	122 MAPLE STREET	DRESDEN, TN	8	0	0	0	0	0	0.0	
TN0171	MAIN OFFICE	309 CHURCH ST	DYERSBURG, TN	15	0	0	0	0	0	0.0	
TN0179	MAIN OFFICE	901 WEST ELK AVE	ELIZABETHTON, TN	23	0	0	0	0	0	0.0	
TN0187	MAIN OFFICE	123 N MAIN STREET	ERWIN, TN	10	0	1	8	1	9	24.7	
TN0196	MAIN OFFICE	226 EAST COLLEGE ST	FAYETTEVILLE, TN	19	0	9	5	0	5	5.2	PLACEMENT SHEETS NOT RECIEVED
TN0204	MAIN OFFICE	810 OAK MEADOW DRIVE	FRANKLIN, TN	25	0	21	3	0	3	9.5	DETECTORS HAVE BEEN RECIEVED
TN0210	MAIN OFFICE	380 W MAPLE STREET	GALLATIN, TN	15	0	0	0	0	0	0.0	
TN0217	MAIN OFFICE	CEDAR & MAIN STS	GLEASON, TN	7	0	1	6	0	6	19.6	PLACEMENT SHEETS NOT RECIEVED
TN0224	MAIN OFFICE	BROAD ST-US HWY 41	GREENBRIER, TN	2	0	0	0	0	0	0.0	
TN0225	MAIN OFFICE	220 W SUMMER ST	GREENEVILLE, TN	16	0	0	0	0	0	0.0	
TN0226	MAIN OFFICE	BROAD ST	GREENFIELD, TN	3	0	0	0	0	0	0.0	
TN0234	MAIN OFFICE	815 SOUTH ROAN	HARRIMAN, TN	8	0	7	1	0	1	4.3	
TN0243	MAIN OFFICE	IMPERIAL BLVD	HENDERSONVILLE, TN	12	0	0	0	0	0	0.0	
TN0246	MAIN OFFICE	3908 LEBANON ROAD	HERMITAGE, TN	14	0	0	0	0	0	0.0	
TN0251	MAIN OFFICE	5024 HIXSON PIKE	HIXSON, TN	11	0	0	0	0	0	0.0	
TN0256	MAIN OFFICE	HWY 64	HORNSBY, TN	1	0	0	0	0	0	0.0	
TN0257	MAIN OFFICE	1420 OSBORNE ST	HUMBOLDT, TN	14	0	14	0	0	0	3.7	
TN0258	MAIN OFFICE	100 COURT SQUARE	HUNTINGDON, TN	8	0	7	1	0	1	6.4	
TN0260	MAIN OFFICE	POTTER ST AT COURT SQ	HUNTSVILLE, TN	8	0	8	0	0	0	2.5	
TN0265	MAIN OFFICE	LIBERTY & MAIN STS	JACKSBORO, TN	3	0	0	0	0	0	0.0	
TN0267	GMF	200 MARTIN L KING JR	JACKSON, TN	21	0	0	0	0	0	0.0	
TN0275	MAIN OFFICE	200 E ANDREW JOHNSON	JEFFERSON CITY, TN	12	0	0	8	3	11	55.6	
TN0277	MAIN OFFICE	300 NORTH MAIN STREET	JELLICO, TN	12	0	2	7	2	9	35.3	
TN0282	MAIN OFFICE	530 EAST MAIN ST	JOHNSON CITY, TN	70	0	25	36	3	39	40.8	
TN0287	MAIN OFFICE	320 W CENTER ST	KINGSPORT, TN	56	13	50	5	0	5	9.7	
TN0293	MAIN OFFICE	424 N. KENTUCKY ST	KINGSTON, TN	8	0	7	1	0	1	5.8	
TN0296	VMF	1601 MCCALLA	KNOXVILLE, TN	19	0	16	3	0	3	5.6	
TN0299	FOUNTAIN CITY STATIO	LYNNWOOD DRIVE	KNOXVILLE, TN	18	2	16	2	0	2	8.6	
TN0301	NORTH KNOXVILLE STA	2600 NORTH BROADWAY	KNOXVILLE, TN	23	1	20	3	0	3	5.9	
TN0310	DOWNTN.STA.ADD'L.PKG	COR.HENLEY & CUMBERLA	KNOXVILLE, TN	90	0	67	17	0	17	19.5	
TN0682	P & D CENTER	1237 E WEISGARBER RD	KNOXVILLE, TN	242	24	232	10	0	10	9.0	
TN0756	SOUTH STATION	137 YOUNG HIGH PIKE	KNOXVILLE, TN	23	2	20	1	0	1	5.1	

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TN0757	CONCORD STATION	124 HUXLEY DRIVE	KNOXVILLE, TN	19	0	17	2	0	2	4.6	
TN0759	BURLINGTON STATION	300 MACEDONIA	KNOXVILLE, TN	23	1	20	2	0	2	5.8	
TN0314	MAIN OFFICE	E LOCUST ST & MCDONAL	LAFAYETTE, TN	16	0	1	8	1	9	50.5	
TN0000	CROSS MTN ANTENNA	CROSS MOUNTAIN	LAKE CITY, TN	12	0	12	0	0	0	1.5	
TN0324	MAIN OFFICE	218 NORTH MILITARY AV	LAWRENCEBURG, TN	15	0	0	0	0	0	0.0	
TN0328	MAIN OFFICE	217 EAST BROADWAY	LENOIR CITY, TN	10	0	0	7	3	10	50.8	
TN0330	MAIN OFFICE	SE COR HWY 43 & 98	LEOMA, TN	2	0	1	1	0	1	6.3	PLACEMENT SHEETS NOT RECIEVED
TN0331	MAIN OFFICE	557 E COMMERCE	LEWISBURG, TN	11	0	9	2	0	2	6.7	PLACEMENT SHEETS NOT RECIEVED
TN0332	MAIN OFFICE	26 SOUTH BROAD STREET	LEXINGTON, TN	9	0	0	0	0	0	0.0	
TN0336	MAIN OFFICE	105 S. COURT SQUARE	LIVINGSTON, TN	9	0	3	5	0	5	12.5	
TN0340	MAIN OFFICE	US 11	LOUDON, TN	8	0	0	3	1	4	30.7	
TN0355	MAIN OFFICE	323 E OLD HICKORY BLV	MADISON, TN	10	0	0	0	0	0	0.0	
TN0351	MAIN OFFICE	120 S HIGHLAND DR	MCKENZIE, TN	15	0	0	0	0	0	0.0	
TN0353	MAIN OFFICE	COR MORFORD & COURT S	MCMINNVILLE, TN	1	0	0	0	0	0	0.0	PLACEMENT SHEETS NOT RECIEVED
TN0686	BULK MAIL CENTER	1921 ELVIS PRESELY BL	MEMPHIS, TN	299	8	284	15	0	15	11.2	
TN0688	GMF	555 SOUTH THIRD ST.	MEMPHIS, TN	327	8	315	12	0	12	16.4	
TN0427	MAIN OFFICE	803 SOUTH CUMBERLAND	MORRISTOWN, TN	10	0	1	8	1	9	32.3	
TN0692	GMF	525 ROYAL PARKWAY	NASHVILLE, TN	238	10	216	12	0	12	16.7	
TN0483	MAIN OFFICE	301 S TULANE AVE	OAK RIDGE, TN	18	0	18	0	0	0	3.3	
TN0484	JACKSON SQUARE STA	ADMINISTRATION RD.	OAK RIDGE, TN	250	0	0	0	0	0	0.0	
TN9999	MAIN OFFICE	333 E. WEST MAIN STRE	OAK RIDGE, TN	28	0	1	0	0	0	0.8	
TN0491	MAIN OFFICE	103 SECOND AVENUE	ONEIDA, TN	17	8	2	7	0	7	10.3	
TN0520	MAIN OFFICE	3329 SHROPSHIRE BLVD	POWELL, TN	25	2	24	0	1	1	22.7	
TN0543	MAIN OFFICE	340 W ROCKWOOD ST	ROCKWOOD, TN	10	1	4	5	0	5	6.3	
TN0544	MAIN OFFICE	203 W. MAIN STREET	ROGERSVILLE, TN	10	1	2	7	0	7	12.3	
TN0562	MAIN OFFICE	U S 411	SEVIERVILLE, TN	27	0	22	4	1	5	21.3	
TN0579	MAIN OFFICE	DAYTON PIKE (HWY 21)	SODDY DAISY, TN	10	0	10	0	0	0	2.5	
TN0605	MAIN OFFICE	701 N MAIN ST	SWEETWATER, TN	7	0	0	6	1	7	22.0	
TN0636	MAIN OFFICE	MAIN ST & MAIDEN LANE	WARTBURG, TN	7	0	7	0	0	0	3.8	
TX1903	MAIN OFFICE	341 PINE ST	ABILENE, TX	49	2	45	1	0	1	5.7	
TX0080	DOWNTOWN STATION	BRYAN & ERVAY STS	DALLAS, TX	47	4	25	17	1	18	23.6	
TX1910	BULK MAIL CENTER	2400 DALLAS-FTW TNPK	DALLAS, TX	291	24	244	23	0	23	16.8	
TX1916	GMF	401 DALLAS-FT WORTH T	DALLAS, TX	435	9	373	38	4	42	50.5	
TX0625	MAIN OFFICE	327 E CALIFORNIA ST	GAINESVILLE, TX	48	2	37	8	1	9	29.6	

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TX0317	MAIN OFFICE	231 LAMAR AVE	PARIS, TX	32	2	22	8	0	8	13.0	
TX1671	MAIN OFFICE	106 WEST FOURTH ST	PECOS, TX	18	2	16	0	0	0	2.8	
TX1865	DOWNTOWN STATION	800 FRANKLIN	WACO, TX	86	0	0	0	0	0	0.0	
UT0066	MAIN OFFICE	125 EAST 100 N	HEBER CITY, UT	9	0	4	5	0	5	5.8	
UT0204	MAIN OFFICE	65 NORTH MAIN ST	TOOELE, UT	18	1	12	5	0	5	8.0	

Total Post Offices Tested: 243
Total Detectors Shipped: 14201
Total Detectors Lost: 662

	0 to 4	4 to 20	>=20	>=4
Total Detectors with PCIL Values:	8409	1158	72	1230

Average PCIL Value: 1.5
Highest PCIL Value: 87.4

APPENDIX B

U.S. POSTAL SERVICE CHARCOAL TESTING DATA (1992)

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ABILENE, TX
3RD & PINE STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365456		TRAVEL BLANK	0.0	TRAVEL BLANK
1365120	AH	ON ELECTRICAL BOX	0.2	BASEMENT-AIR HANDLER ROOM
1365282	AH-1	ON ELECT BOX BEHIND PIPES	0.9	BASEMENT
1365141	AH-1	ON WOODEN CABINET 'F'	0.7	BASEMENT - AIR HANDLER ROOM
1365014	APWU	ON LOCKER #156	0.8	BASEMENT
1365012	B0001	ELEC BOX OUTSIDE WALL	0.8	BASEMENT
1365130	B001	ABOVE LIGHT FRONT OF STORAGE	1.0	BASEMENT
1365019	B001	ABOVE SAFETY EQUIP SIGN	0.8	BASEMENT-NEXT TO CARPENTER SHP
1365024	B001	BACK LEFT CORNER ON SHELF	---	BASEMENT - LOST
1365704	B001	BEHIND PARTITION UNDER CLOCK	0.9	BASEMENT
1365747	B001	BY CLOCK NEXT TO OUTSIDE DOOR	1.1	BASEMENT
1365137	B001	BY FIRST AID KIT AROUND CORNER	0.8	BASEMENT
1365612	B001	CONCRETE SLAB NEXT TO PILLAR	1.6	BASEMENT
1365128	B001	CORNER ON FLOOR BY BREAK RM	0.9	BASEMENT
1365005	B001	ELEC BOX NW CORNER	0.7	BASEMENT
1366005	B001	ELECT OUTLET LEFT HAND CORNER	1.1	BASEMENT
1365112	B001	EMERG LIGHT #6 BACK OF ROOM	0.7	BASEMENT
1365104	B001	IN CAGE STORE ROOM CAB. #2E04	1.1	BASEMENT
1365021	B001	IN SHOP BY MAIL BOXES BACK SHF	1.1	BASEMENT
1365153	B001	ON CHAIR ALCOVE BEHIND BRK RM	0.8	BASEMENT
1365169	B001	ON CUP IN CENTER OF ROOM	0.8	BASEMENT
1365150	B001	ON FLOOR IN CORNER	0.8	BASEMENT
1365013	B001	ON FLOOR NEAR FIRE EXT	1.0	BASEMENT DUPLICATE
1365164	B001	ON FLOOR NEAR FIRE EXT IN CORN	0.6	BASEMENT
1365111	B001	ON FLOOR NET TO FIRE EXTINGUIS	0.7	BASEMENT
1365132	B001	ON SAFE TO THE RIGHT	0.8	BASEMENT
1365162	B001	ON SHELF BY FOIRST AID BOX	0.8	BASEMENT NXT TO SHOP RT SIDE
1365133	B001	ON WHITE CABINET RT MAIL BOXES	1.1	BASEMENT
1365161	B001	STORE ROOM	1.5	BASEMENT
1365023	B001	STORE ROOM [AS ABOVE]	1.9	BASEMENT [DUPLICATE]
1366283	B001	TOP OF PARTITION WALL	0.9	BASEMENT OVER EXIT SIGN
1365440	B003	FILE CABINET UNDER CLOCK	1.1	BASEMENT-STORAGE
1365000	B003	ON CABINET 'Q1' FRONT OFFICE	0.9	BASEMENT
1365147	B004	ON TABLE	2.3	BASEMENT-STORAGE
1365416	B006	JANITOR J ON PAPER SUPPLY SHLF	1.5	BASEMENT
1365125	B007	BACK LEFT CORNER ON SHELF	0.6	BASEMENT-STORAGE
1365117	B007	BACK WALL TABLE NEAR PAPER CUT	0.9	BASEMENT-STORAGE
1365121	B007	FRONT WALL SHELF 'EM'	1.3	BASEMENT-STORAGE
1365391	B007	ON RIGHT WALL SHELF 'BC'	0.8	BASEMENT-STORAGE
1365127	B008	WOMEN'S RM ON TOWEL DISPENSER	2.7	BASEMENT
1365126	B010-B012	ON LEFT SIDE FILE CABINET	0.8	BASEMENT MAINTENANCE OFICE
1365396	B010-B012	RT SIDE ON CABINET	0.6	BASEMENT -MAINTENANCE OFFICE
1365163	B014	FMO SHOP IN STAIRWELL ON CUP	0.8	BASEMENT
1365113	B014	FRONT LF SIDE ON CABINET 3A03	0.6	BASEMENT
1365144	B014	FRONT LF SIDE ON CABINET 3A03	0.6	BASEMENT-DUPLICATE
1365143	B014	RT SIDE ON CABINET	0.9	BASEMENT
1365108	B015	TABLE NEXT TO TYPEWRITER	0.7	BASEMENT-OFFICE
1365387	B016-B018	ABOVE COAT RACK	0.9	BASEMENT
1365167	B016-B018	CONFERENCE ROOM ON TABLE	0.9	BASEMENT
1365432	B020	MEN'S RM ON WINDOW SILL	1.0	BASEMENT
1365118	B022	ON SHELF LEFT SIDE	5.1	BASEMENT-JANITOR [DUP]
1365678	B102	IN CAGE ON GREEN SHELF	0.6	BASEMENT

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ABILENE, TX
3RD & PINE STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365003	B102	ON ELECTRICAL BOX	0.9	BASEMENT - MAINTENANCE OFFICE
1365008	B102	ON FILE CABINET CAGE AREA	0.6	BASEMENT
1365011	B102	ON FILE CABINET IN CAGE	0.7	BASEMENT - DUPLICATE
1365134	B201	OLD STEAM ROOM IN CUP ON FLOOR	0.5	BASEMENT
1365136	B202	WOMEN'S ROOM ON LOCKER #10	0.4	BASEMENT-WOMEN'S CHANGE RM
1365151	B205	ON LOCKER #1	0.5	BASEMENT-LOCKER ROOM
1365394	B205	ON LOCKER #24	0.1	BASEMENT-LOCKER ROOM
1365160	B205	ON LOCKER #33	0.1	BASEMENT-LOCKER ROOM
1365430	B205	ON LOCKER #89	0.4	BASEMENT-LOCKER ROOM
1365025	B301	METAL SHELF RT BACK CORNER	0.4	BASEMENT ELECTRICAL RM [DUP]
1365681	B301	ON METAL SHELF RT BACK CORNER	0.5	BASEMENT ELECTRICAL ROOM
1365688	B302	ON ELECTRICAL BOX	1.1	BASEMENT
1365698	B302	ON SHELF RT BACK CORNER	1.5	BASEMENT CARPENTER'S SHOP
1365018	B303	ON WOODEN CABINET STRAIGHT AHD	1.4	BASEMENT ELECTRICAL SHOP
1365682	B304A	ON SHELF ABOVE DOOR	1.1	BASEMENT
1365016	B308	ON SHELF #40	0.7	BASEMENT
1365135	B308	ON SHELF #40	0.8	BASEMENT-DUPLICATE
1365119	BO22	ON SHELF LEFT SIDE	5.2	BASEMENT-JANITOR
1365702	BOILER RM	BOILER #1 CABINET	0.9	BASEMENT
1365213	BOILER RM	ELECTRICAL BOX FRONT WALL	0.1	BASEMENT
1365115	BOILER RM	EMERGENCY LIGHT #10 LEFT SIDE	0.7	BASEMENT
1365006	BOILER RM	ON 4TH ELECT BOX RT SIDE WALL	0.7	BASEMENT
1365109	BOILER RM	PANEL 'ML' BACK OF ROOM	0.8	BASEMENT
1365165	CFS	BACK RT CORNER [LOST&FOUND]	0.5	BASEMENT
1365010	CFS	BLUE CABINET NXT 1ST AID BOX	0.8	BASEMENT-MAIL SORT ROOM
1365015	CFS	CTR RM BACK PILLAR ON ELECT BX	1.0	BASEMENT
1365124	CFS	ON A/C DRAIN RT SIDE	1.2	BASEMENT
1365002	CFS	ON SHELF LEFT BACK CORNER	0.9	BASEMENT
1365159	CHILLER RM	ELECTRICAL BOX FRONT WALL	1.3	BASEMENT
1365145	CHILLER RM	ON 24 HR GRAPH MACHINE	1.4	BASEMENT
1365691	FREIGHT EL	BY LIGHT	0.3	BASEMENT - FREIGHT ELEVATOR
1365004	H20 RM	ON BREAK IN CONCRETE WALL	0.9	BASEMENT H20 TREATMENT ROOM
1365099	HALLWAY	ABOVE LIGHT FIXTURE	0.5	BASEMENT
1365168	HALLWAY	EMERGENCY LIGHT #19	0.4	BASEMENT
1365017	HALLWAY	EMERGENCY LIGHT #8	0.3	BASEMENT
1365022	HIGH VOLT	ON ELECTRICAL BOX	0.1	BASEMENT ROOM OPENS FR OUTSIDE
1365020	LOCKER RM	ON LOCKER #23	0.5	BASEMENT
1365009	LOCKER RM	ON LOCKER #24	0.5	BASEMENT
1365687	MACH SHOP	ON MECH SHOP CLOTH CABINET	0.6	BASEMENT
1365410	MAIL RM	CABINET NEXT TO CLUMN F9	---	1ST FLOOR - LOST
1365149	MAIL RM	COLUMN D11-FIRST AID ROOM	0.6	1ST FLOOR
1365148	MAIL RM	COLUMN E11 -ELECTRIC BOX	0.4	1ST FLOOR
1365107	MAIL ROOM	'A13' OFFICE ON SAFE	0.4	1ST FLOOR
1365152	MAIL ROOM	BULK MAIL CAGE 'A12' ELECT BOX	0.3	1ST FLOOR
1365397	MAIL ROOM	CABINET BY 'E8'	---	1ST FLOOR - LOST
1365166	MAIL ROOM	COLUMN G-12 UNDER THERMOSTAT	0.6	1ST FLOOR
1365138	MAIL ROOM	CORNER 'I11'	0.4	1ST FLOOR
1365421	MAIL ROOM	CORNER 'I12' ON CABINET 224	0.5	1ST FLOOR
1365429	MAIL ROOM	CORNER BETWEEN WALL 5&6	0.6	1ST FLOOR
1365424	MAIL ROOM	CORNER BETWEEN WALLS 1&2	---	1ST FLOOR - LOST
1365398	MAIL ROOM	CORNER WALL #8	0.5	1ST FLOOR
1365441	MAIL ROOM	CUP ON FLOOR BEHIND BELT 'B4'	0.4	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ABILENE, TX
3RD & PINE STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365139	MAIL ROOM	CUP ON FLOOR BY PILLAR 'C1'	0.5	1ST FLOOR
1365395	MAIL ROOM	CUP ON FLOOR BY PILLAR 'G1'	0.3	1ST FLOOR
1365386	MAIL ROOM	CUP ON FLOOR BY PILLAR A1	0.4	1ST FLOOR
1365452	MAIL ROOM	FILING CABINET BY VAULT 'F4'	0.1	1ST FLOOR
1365400	MAIL ROOM	GENERAL INFO BOARD 'B8' AREA	0.1	1ST FLOOR
1365156	MAIL ROOM	GREEN CABINET NEAR PILLAR 'F6'	0.3	1ST FLOOR
1365106	MAIL ROOM	IN CORNER BY 'G13'	0.6	1ST FLOOR
1365131	MAIL ROOM	JANITORS CLOSET 'B7' AREA	0.1	1ST FLOOR
1365157	MAIL ROOM	MAIL SORT CAB NEXT TO 'D13'	0.7	1ST FLOOR
1365142	MAIL ROOM	MEN'S RM BY 'B7' ON GREY BOX	0.1	1ST FLOOR
1365446	MAIL ROOM	OAK PIGEON HOLE BY PILLAR 'E3'	0.3	1ST FLOOR
1365389	MAIL ROOM	ON CAGE 'B5' AREA	0.4	1ST FLOOR
1365406	MAIL ROOM	ON TABLE BY PILLAR 'E1'	0.6	1ST FLOOR
1365390	MAIL ROOM	ON TIME CLOCK BOX 'D8' AREA	0.3	1ST FLOOR
1365417	MAIL ROOM	OUTGOING MAIL NEAR LOBBY	0.2	1ST FLOOR
1365110	MAIL ROOM	PILLAR 'B11' ON ELECT BOX	0.1	1ST FLOOR
1365442	MAIL ROOM	PILLAR 'B5' ABOVE FIRE ALARM	0.5	1ST FLOOR
1365407	MAIL ROOM	PILLAR 'C11' ON ELECT BOX	0.6	1ST FLOOR
1365098	MAIL ROOM	PILLAR 'C13' IN CUP ON FLOOR	0.8	1ST FLOOR
1365409	MAIL ROOM	PILLAR 'C2' ON GREEN BOX	0.5	1ST FLOOR
1365423	MAIL ROOM	PILLAR 'C4' ON ELECT BOX	0.8	1ST FLOOR
1365449	MAIL ROOM	PILLAR 'C4' ON ELECT BOX	0.6	1ST FLOOR
1365101	MAIL ROOM	PILLAR 'C7' ON ELECT BOX	0.3	1ST FLOOR
1365436	MAIL ROOM	PILLAR 'C9' ON ELECT BOX	0.3	1ST FLOOR
1365154	MAIL ROOM	PILLAR 'D3' BY RED DOWN ARROW	0.3	1ST FLOOR
1365412	MAIL ROOM	PILLAR 'E13' IN CUP ON FLOOR	0.5	1ST FLOOR
1365431	MAIL ROOM	PILLAR 'F7' ON ELECT BOX	0.3	1ST FLOOR
1365403	MAIL ROOM	PILLAR 'F9' ON POWER BOX	0.4	1ST FLOOR
1365129	MAIL ROOM	PILLAR 'H11' ON ELECT BOX	0.5	1ST FLOOR
1365448	MAIL ROOM	PILLON 'D5' ON PIPE	0.6	1ST FLOOR
1365392	MAIL ROOM	TOP OF CAGE 'D4' AREA	0.3	1ST FLOOR
1365405	MAIL ROOM	TOP OF STAIRS EAST SIDE OF BLD	0.6	1ST FLOOR
1365435	MAIL ROOM	WALL #11 BY FIRE EXT ON FLOOR	0.1	1ST FLOOR
1365100	MAIL ROOM	WALL ACROSS 'B10' ON ELECT BOX	0.3	1ST FLOOR
1365408	MAIL ROOM	WINDOW SILL BETWEEN A2-A3	0.3	1ST FLOOR
1365140	MAIL ROOM	WINDOW SILLL BY A12 [STAIRS]	0.2	1ST FLOOR
1365427	MAIL ROOM	WOMEN'S LOUNGE ON LOCKER #9	0.2	1ST FLOOR
1365420	MAIL ROOM	WOMEN'S ROOM ON TOWEL DISPENSE	0.2	1ST FLOOR
1365001	MECH SHOP	ON ELECT BOX BACK OF ROOM	1.1	BASEMENT
1365146	MEN'S RM	LEFT SIDE BY LOOKOUT	1.3	BASEMENT-CHANGE ROOM
1365102	MEN'S RM	RIGHT SIDE LOOKOUT	1.7	BASEMENT-CHANGE ROOM
1365445	N STAIRS	ON EMERGENCY LIGHT #40	0.8	BASEMENT
1365722	N. ELEV	LEFT HAND CORNER ABOVE LIGHT	0.3	BASEMENT
1366277	PAINT SHOP	1ST RED CABINET ON RT #2D04	0.5	BASEMENT
1365100	PAINT SHOP	ON CABINET #2D08	0.3	BASEMENT
1365155	S. ELEV	IN OLD PHONE BOX	0.4	BASEMENT
1365123	S.STAIRS	EMERGENCY LIGHT #32	1.1	BASEMENT
1365116	STAIRWELL	EMERGENCY LIGHT #13	0.6	BASEMENT-LOCKER ROOM
1365703	STAIRWELL	ON EMERGENCY LIGHT #28	0.7	BETWEEN BOILER RM AND B001
1365122	SWING RM	BACK WALL DR PEPPER MACHINE	0.5	BASEMENT
1365103	SWING RM	BACK WALL ON VENDING MACHINE	0.7	BASEMENT
1365114	SWING RM	BACK WALL WINDOW SILL	0.6	BASEMENT-SMOKING AREA

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ABILENE, TX
3RD & PINE STREETS

Detector ID#	Room #	Location	PCi/L		Comments
1365105	SWING RM	LEFT SIDE ON METAL CABINET	0.3	BASEMENT	
1365158	SWING RM	ON MICROWAVE RIGHT SIDE	0.5	BASEMENT	

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ABILENE, TX
3RD & PINES STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365401	MAIL ROOM	NEXT TO D9 ON CABINET 340	0.6	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ADA, OK
TWELFTH & RENNIE STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1366191		TRAVEL BLANK	0.2	TRAVEL BLANK
1366189	220	LEFT OF JUDGE'S BENCH	0.5	2ND FLOOR
1366141	229	OUTSIDE OF PIPE CHASE	0.9	2ND FLOOR
1366211	311	TOP OF METAL WALL NX PIPE CHAS	0.6	3RD FLOOR
1366089	312	ON WINDOW SILL	1.2	THIRD FLOOR
1366145	B1	TOP OF CABINET	0.2	BASEMENT
1366142	B10	ON TABLE	1.6	BASEMENT
1366209	B11	AROUND CORNER ON SHELF	1.7	BASEMENT
1366160	B12	SUPPLY RM BY XMAS TRE	0.8	BASEMENT
1366130	B15	MEN'S ROOM	0.3	BASEMENT
1366185	B15	ON LOCKERS	1.0	BASEMENT
1366171	B6	ON CHAIR	1.5	BASEMENT
1366169	B8	ON SHELF NEXT TO ELEC BX	1.8	BASEMENT
1366188	B9	NEXT TO CHARMIN	0.7	BASEMENT
1366192	BASEMENT	ENTRANCE TO CRAWL SPACE	2.6	IN UNFINISHED BASEMENT
1366154	BASEMENT	UNFINISHED	2.7	1200 SQFT EXPOSED SOIL W/DUCT
1366197	BASEMENT	UNFINISHED	2.5	BASEMENT-DUPLICATE
1366182	CUBBY HOLE	ON PLASTIC	1.7	BASEMENT
1366206	ELEVATOR	ABOVE LIGHT EAST END	1.7	BASEMENT
1366073	ELEVATOR	LOBBY 1ST FLOOR EASTSIDE	---	1ST FLOOR [LOST]
1366172	MAIL ROOM	EMERG LIGHT NEAR WOMEN'S ROOM	0.9	1ST FLOOR
1366201	MAIL ROOM	ON SHELF ABOVE PO BOXES	0.5	1ST FLOOR
1366196	MAIL ROOM	PIGEON HOLE	0.1	1ST FLOOR
1366207	MECH RM	ON ELECTRIC BOX IN CORNER	0.7	BASEMENT
1366072	MECH ROOM	PIGEON HPOLE	0.4	BASEMENT
1366210	NEAR ELEV	NEXT TO EASTEND ELEVATOR	1.1	3RD FLOOR
1366170	NEAR ELEV	NEXT TO ELEVATOR EASTEND	1.1	2ND FLOOR
1366162	SMOKING RM	ON ELECTRICAL BOX	0.4	BASEMENT
1366204	STAIRWELL	ON GLASS CABINET	1.9	STAIRS TO CUSTOMER LOBBY
1366150	STAIRWELL	ON LOCKER	0.8	BASEMENT

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ALLENTOWN, PA
850 NORTH 5TH STREET

Detector ID#	Room #	Location	PCi/L	Comments
1365341		RM TO SIDE OF STOCKROOM IN CUP	2.6	RT CORNER OF RM
1365324		TRAVEL BLANK	0.1	TRAVEL BLANK
1365377		TRAVEL BLANK	0.1	TRAVEL BLANK
1365329	100	TOP OF ELECTRICAL BOX	0.6	2ND FLOOR
1365328	101	ON TO ELECTRICAL BOX	0.4	
1365276	104	BATHROOM ON TOWEL DISPENSER	0.7	
1365292	104	LEFT HAND CORNER	0.5	
1365327	106	LEFT HAND CORNER	0.5	
1365249	106	RIGHT HAND CORNER	0.5	
1365317	108	LEFT HAND CORNER	1.0	
1365360	108	LEFT HAND CORNER	0.9	DUPLICATE
1365300	108	TOP OF ELECTRICAL EQUIPMENT	0.7	
1365282	108	VAULT 4TH SHELF METAL CABINET	0.9	
1365370	110	CLASSROOM TOP OF CABINET	1.1	
1365260	2	MAINT OFFICE TOP ELECT PANEL	11.8	
1365277	20	LEFT SIDE CLOSET 3RD CLOSET	0.2	
1365322	20	OCCUPIED ROOM	0.1	
1365326	20	RT SIDE CLOSET ON 4TH SHELF	0.4	
1365264	20C	MENS'S RM ON TOWEL DISPENSER	0.6	
1365385	20C	RT CORNER OF ROOM	0.9	
1365258	20F	LEFT SIDE IN CUPT	0.5	
1365253	22	LEFT SIDE OF RM CORNER IN CUP	3.4	DUPLICATE
1365352	22	LEFT SIDE OF RM CORNER IN CUP	3.6	
1365248	22	SMALL RM TO LEFT IN CUP	4.3	
1365342	3	BATHROOM TO LEFT OF SMALL RM	1.1	
1365373	3	SMALL RM ON RIGHT IN CUP	0.8	
1365244	4	TOP OF ELECTRICAL PANEL	0.6	
1365271	BOILER RM	BOILER PIT TOP BROWN CABINET	1.2	
1365272	BOILER RM	RIGHT SIDE ON TABLE	1.7	RM BESIDE STOCK ROOM
1365308	LADIES RM	TOP OF TOWEL DISPENSER	0.5	MAIL RM FLOOR
1365320	LOBBY	FRON TOF WINDOWS 3&4	0.5	2ND FLOOR
1365314	LOBBY	TOP OF PO BOXES MID ROOM	0.8	
1365290	LOCKER RM	TOP OF LOCKER W/LARGE POSTER	0.9	1ST RM DOWNSTAIRS
1365296	LUNCH RM	1ST ROOM ON LEFT IN CUP	0.9	
1365285	LUNCH ROOM	LARGE RM ON LEFT IN CORNER	1.4	
1365259	LUNCH ROOM	LARGE ROOM RIGHT SIDE	1.2	
1365372	LUNCH ROOM	LARGE ROOM SMALL CLOSET	3.3	DUPLICATE
1365375	LUNCH ROOM	ON LEFT SIDE	0.9	
1365378	LUNCHROOM	SAMLL CLOSET ON RIGHT	0.5	
1365335	MAIL RM	CLERK'S SIDE MID PO BOXES	0.5	
1365313	MAIL RM	CLERK'S SIDE ON CABINET	0.5	
1365295	MAIL RM	CLERK'S SIDE ON SAFE RT SIDE	0.4	
1365251	MAIL RM	ENTRANCE FROM OUTSIDE ON SAFE	0.7	
1365255	MAIL RM	FR ELEVATOR TOP OF WHITE BOX	---	LOST
1365351	MAIL RM	TOP OF 1ST AID BOX	0.8	
1365286	MAIL RM	TOP OF ELECT BOX 1ST COLUMN	---	LOST
1365294	MAIL RM	UNDER NO SMOKING SIGN	0.7	
1365304	MAIL RM	UNDER NO SMOKING SIGN	0.1	DUPLICATE
1365305	MEN'S RM	ACROSS FROM RM 4 TOWEL DISPEN	1.6	
1365332	MEN'S RM	TOP OF TOWEL DISPENSER	0.5	DUPLICATE
1365337	MEN'S RM	TOP OF TOWEL DISPENSER	0.5	2ND FLOOR
1365368	MEN'S RM	TOP OF TOWEL DISPENSER	0.2	MAIL ROOM FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ALLENTOWN, PA
850 NORTH 5TH STREET

Detector ID#	Room #	Location	PCi/L	Comments
1365288	PAINT RM	IN CORNER ON TOP OF PANELING	2.4	ROOM LEFT OF BATHROOM
1365338	STOCK ROOM	RT SIDE OF LARGE RM ON CABINET	7.1	
1365280	WASH ROOM	ON TOWEL DISPENSER	1.3	IN STOCK ROOM

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS BIG SPRING, TX
5TH & MAIN STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1366272		TRAVEL BLANK	0.1	TRAVEL BLANK
1366337	B02	ON LOCKER #36	1.6	BASEMENT
1366235	B02	ON METAL SHELF	1.5	BASEMENT-DUPLICATE
1366242	B03	ON TOP OF GREEN LOCKERS	3.0	BASEMENT
1366212	B03 CS	ON FLOOR IN UP	1.7	BASEMENT - CRAWL SPACE [DUP]
1366247	B04	ON CABINET BY ELEV CONTROL RM	1.7	BASEMENT
1366236	B04	ON EMERG LIGHT BY STAIRS/RAMP	1.9	BASEMENT
1366246	B04	ON LIGHT FIXTURE	1.7	BASEMENT
1366286	B04 CS	ON FLOOR IN CUP	1.6	BASEMENT - CRAWL SPACE
1366285	B05	ON SHELF ABOVE ELECTRICAL BOX	1.5	BASEMENT
1366219	B06	ON ELECTRICAL BOX RIGHT SIDE	2.0	BASEMENT
1366232	B06	ON LIGHT FIXTURE LEFT SIDE	1.9	BASEMENT
1366234	BO2	OFFICE - CUP IN FLOOR	1.4	BASEMENT
1366231	BO3 CS	IN CUP ON FLOOR	1.9	BASEMENT - CRAWL SPACE
1366223	BY ELEV	2ND FLOOR ON DIRECTORY	1.7	2ND FLOOR
1366256	CHILLED WA	ON SHELF IN BACK	9.4	BASEMENT GENERATOR ROOM
1366227	CRAWL SPAC	IN CUP ON DIRT FLOOR	13.4	BASEMENT ADJ TO GENERATOR ROOM
1366225	CRAWL SPAC	ON CONCRETE POST DIRT FLOOR	11.9	BASEMENT DIRT FLOOR
1366241	CRAWL SPAC	ON CONCRETE POST DIRT FLOOR	---	BASEMENT [LOST]
1366243	ELEVATOR	LEFT SIDE IN LIGHT FIXTURE	1.4	BASEMENT
1366220	GENERATOR	ON SHELF	8.5	BASEMENT-DUPLICATE
1366259	MAIL RM	CORNER ACROSS-SAFETY BULLETIN	1.7	1ST FLOOR
1366264	MAIL ROOM	ABOVE CARRIER CASE #17	1.4	1ST FLOOR
1366374	MAIL ROOM	EAST SIDE BY TIME CLOCK	1.4	1ST FLOOR
1366224	MAIL ROOM	EAST STAIRWELL	1.3	1ST FLOOR
1366245	MAIL ROOM	EMERGENCY LIGHT #2	1.8	1ST FLOOR
1366244	MAIL ROOM	EMERGENCY LIGHT #3	1.6	1ST FLOOR
1366215	MAIL ROOM	PIGEON HOLE WEST CORNER	1.5	1ST FLOOR
1366248	MEN'S RM	NEXT TO FAN SWITCH	1.5	1ST FLOOR NEXT TO SUPR OFFICE
1366275	STAIRWELL	BOTTOM OF STAIRS 1ST FLOOR	1.1	1ST FLOOR
1366371	STAIRWELL	BOTTOM OF STAIRS IN CUP	1.9	BASEMENT
1366230	STAIRWELL	TOP OF 1ST FLOOR STAIRS	1.6	1ST FLOOR
1366271	STAIRWELL	TOP OF STAIRS 2ND FLOOR	1.5	2ND FLOOR
1366255	TOOL RM	ON SHELF	2.2	BASEMENT
1366237	VAULT	ON SHELF	2.5	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS CLOVIS, NM
5TH & GIDDINGS

Detector ID#	Room #	Location	PCi/L	Comments
1366356		TRAVEL BLANK	0.1	TRAVEL BLANK
1366261	38	SUPPLY RM ON SHELF IN BACK	1.5	1ST FLOOR
1366329	BOILER RM	ON MAILBOX	0.2	1ST FLOOR-CONTINUOUS MOITOR
1366336	BOILER RM	ON MAILBOX	0.1	1ST FLOOR
1366349	BULK RATE	BOOK SHELF NEXT TO FAKE PLANT	0.8	1ST FLOOR
1366364	BY ELEV	2ND FLOOR MARKEE	0.7	2ND FLOOR
1366377	BY ELEV	ON TOP OF MARKEE	---	1ST FLOOR [LOST]
1366280	CFS	ON BACK SHELF	0.9	1ST FLOOR
1366291	CUSTODIAL	ON SHELF	0.7	1ST FLOOR
1366355	IN ELEV	ON LIGHT SHELF	1.0	1ST FLOOR
1366361	LOCKER RM	ABOVE LOCKER #13 'MR FRENCH'	0.9	1ST FLOOR
1366324	MAIL RM	BACK LEFT CORNER ON LOCKER #1	0.7	1ST FLOOR
1366304	MAIL RM	METAL SHELF LEFT SIDE	0.7	1ST FLOOR
1366332	MAIL RM	ON EMERG LIGHT ON BACK RT WALL	0.9	1ST FLOOR
1366373	MAIL RM	ON METAL CABINEET RT OF CLOCK	0.7	1ST FLOOR
1366312	MAIL RM	ON SHELF NEXT TO FAN	0.7	1ST FLOOR
1366333	MAINT OFF	ON DOUBLE DOOR CABINET	0.6	1ST FLOOR
1365999	MECH RM	PIGEON HOLE	0.3	1ST FLOOR
1366357	MEN'S RM	ON WALL ABOVE MIRROR	0.8	1ST FLOOR
1366335	PM BATH	ON WALL	0.4	1ST FLOOR PM=POST MASTER
1366326	PM OFFICE	ON BEIGE FILE CABINET	0.7	1ST FLOOR
1366318	REST ROOM	ON WOODEN CABINET	0.6	1ST FLOOR
1366037	SKD	ON SHELF	0.9	1ST FLOOR
1366320	SKD	ON SHELF	0.7	1ST FLOOR DUPLICATE
1366353	SPO #112	ON BOOKCASE (GLASS FRONT)	0.8	1ST FLOOR
1366379	STAIRWELL	BOTTOM OF STAIRS	0.6	1ST FLOOR
1366372	STAIRWELL	ON LIGHT TOP OF STAIRS	0.7	2ND FLOOR
1366288	SUPPLY RM	ON SHELF NEXT TO CLOCK	0.6	1ST FLOOR
1366268	SWING RM	ON LOCKER #15	1.8	1ST FLOOR
1366260	SWING RM	ON LOCKER #25	0.6	1ST FLOOR
1366269	VAULT	TOP OF SHELF RIGHT SIDE	7.0	1ST FLOOR
1366370	VOMA	TOP OF SHELF NEXT TO SPEAKER	1.0	1ST FLOOR
1366276	VOMA	TOP SHELF NEXT TO SPEAKER	1.1	1ST FLOOR DUPLICATE
1366316	WOMEN'S RM	ABOVE LOCKER #14	0.9	1ST FLOOR
1366065	WORK SHOP	ON SHELF	0.5	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS DALLAS, TX
BRYAN & ERVAY STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365198		TRAVEL BLANK	0.0	TRAVEL BLANK
1365657	10	BATHROOM METAL CABINET	0.8	BASEMENT
1365604	10	BATHROOM ON WINDOW SILL	1.3	BASEMENT
1365616	10	FILE CABINET	0.6	BASEMENT
1365634	10	IN CLOSET RIGHT HAND WALL	0.9	BASEMENT
1365665	10A	BATHROOM TOP TOWEL DISPENSER	0.7	BASEMENT-BREAK ROOM
1365624	10A	TOP OF LOCKER #8	0.6	BASEMENT
1365626	10A	TOP OF REFRIGERATOR	0.8	BASEMENT-BREAKROOM
1365632	15	RT BACK CORNER CUP ON FLOOR	1.2	BASEMENT
1365731	15	RT BACK CORNER CUP ON FLOOR	1.2	BASEMENT
1365612	17	BACK LEFT CORNER	1.6	BASEMENT
1365653	17	BACK WALL METAL SHELF BOX 193	1.5	BASEMENT
1365711	17	LIGHT SWITCH LEFT FRONT COLUMN	1.3	BASEMENT
1365060	20	BREAK RM BACK WINDOW SILL	0.4	BASEMENT
1365079	20	CUP BOTTOM OF STAIRS	0.4	BASEMENT
1365062	20	WOMEN'S RM ABOVE MIRROR	0.7	BASEMENT
1365719	21A	ELECT BOX RT SIDE	0.9	BASEMENT
1365660	22A	LEFT INSIDE DOOR O PIPE	1.6	BASEMENT
1365605	22A	METAL CARRIER	1.8	BASEMENT
1365643	24B	BACK WALL WINDOW SILL	2.2	BASEMENT
1365631	24B	ON FILE CABINET #5	1.7	2ND FLOOR
1365627	24B	OVER DOOR INSIDE	2.0	2ND FLOOR
1365611	25A	CUP ON FLOOR BACK LEFT WALL	3.2	BASEMENT
1365610	25A	FRONT WALL ABOVE DOOR FRAME	1.8	BASEMENT
1365773	25A	IN CUP BACK RT CORNER	2.6	2ND FLOOR
1365609	25A	TOP OF SHREDDER	2.8	BASEMENT
1365710	26	ON WHITE FILE CABINET	8.7	BASEMENT
1365633	27	RT WALL BOOK LEDGE	1.3	BASEMENT
1365671	28	BACK WALL ON WINDOW SILL	2.2	BASEMENT
1365619	28	LEFT WALL IN HOLE	1.6	BASEMENT
1365675	28	RT FRONT SIDE ON DOOR	1.8	BASEMENT
1365628	31	FAR BACK LEFT WINDOW SILL	1.6	BASEMENT
1365777	31	OFFICE FILE CABINET	1.5	BASEMENT
1365635	31	TOP BROWN PHOTO MACHINE CTR RM	1.2	BASEMENT
1365767	31	TOP OF MIRROR BACK WALL	1.9	BASEMENT
1365651	31	VAULT DV-11 CUP ON FLOOR FRONT	4.0	BASEMENT
1365606	32	ELECT BOX ON LEFT SIDE	0.6	BASEMENT
1365727	33	ELEC BOX BY NO SMOKING SIGH	1.1	BASEMENT
1365759	33	TOP OF DESK RIGHT SIDE	1.4	BASEMENT
1365648	39	CUP ON FLOOR LEFT CORNER	1.3	BASEMENT RESTAURANT STORAGE
1365650	39	ELECT BOX RT BACK CORNER	1.1	BASEMENT
1365642	39	TOP OF A/C RIGHT CORNER	1.1	BASEMENT
1365622	39	TOP OF FREEZER	1.1	BASEMENT
1365614	41	BOX DATED DESTROY 7-93 CTR RM	1.8	BASEMENT-DUPLICATE
1365772	41	BOX DATED DESTROY 7-93 CTR RM	2.1	BASEMENT
1365532	41	FRONT WALL RT SIDE ABOVE DESK	2.4	BASEMENT
1365662	41	LEFT BACK CORNER FY89 BOX	2.5	BASEMENT
1365607	41	LEFT WALL CORNER	2.2	BASEMENT
1365718	41	RT BACK CORNER ON METAL SHELF	1.6	BASEMENT
1365638	45	SWITCH BOX LEFT WALL	0.8	BASEMENT
1365652	49	IN PLANT POT DIVIDER WALL	0.9	BASEMENT-CAFE DE SAIGON
1365603	51	LEFT BACK LEDGE	0.7	BASEMENT

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS DALLAS, TX
BRYAN & ERVAY STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365668	52	ON EMPTY DESK	0.8	BASEMENT
1365659	53	PALLET ON FRONT WALL	1.8	BASEMENT
1365669	53	PIGEON HOLE BACK WALL	2.0	BASEMENT
1365647	54	LEDGE ABOVE DOOR	0.3	BASEMENT-STORAGE
1365617	54	TOP WOODEN SHELF LF BACK CORN	0.2	BASEMENT-STORAGE
1365670	55	WOODEN SHELF BACK WALL	1.3	BASEMENT
1365608	56	WOODEN BEAM RT WALL	1.4	BASEMENT-STORAGE
1365661	59	CUP ON FLOOR LEFT WALL	1.4	BASEMENT-STORAGE
1365771	60	ON LEFT SHELF	0.7	BASEMENT-STORAGE
1365655	B-31	ELECT BOX NEAR SINK	1.3	BASEMENT
1365646	BOILER RM	CUP ON FLOOR RIGHT CORNER	0.4	BASEMENT
1365672	BOILER RM	FAR LEFT CORNER CUP ON FLOOR	0.8	BASEMENT
1365637	BOILER RM	FRONT RT CORNER ON PIPE	0.4	BASEMENT
1365625	BOILER RM	FRONT WALL ELECT BOX	0.5	BASEMENT
1365618	BOILER RM	LOWER LEVEL ON/OFF BOX COLUMN	0.2	BASEMENT
1365644	BOILER RM	SUPPLY AREA ELECT BOX	1.2	BASEMENT
1365639	BOILER RM	TOP SWITCH BOX RT BACK WALL	0.6	BASEMENT
1365654	BOILER RM	WOODEN SHELF BACK CORNER	1.1	BASEMENT
1365033	ELEV #1	FRONT FT CORNER ON LIGHT LEDGE	0.5	BASEMENT
1365673	ELEV #2	BACK LEFT LEDGE	0.2	BASEMENT
1365056	ELEV #2	OUTSIDE ABOVE DOOR	0.6	BASEMENT
1365734	ELEV #3	INSIDE RT FRONT LIGHT LEDGE	0.3	BASEMENT
1365042	ELEV #3	OUTSIDE OVER DOOR	0.4	4TH FLOOR
1365095	ELEV #3	OUTSIDE OVER DOOR	0.8	2ND FLOOR
1365629	ELEV #4	INSIDE RT FRONT LIGHT LEDGE	0.4	BASEMENT
1365029	ELEV 2	OUTSIDE OVER DOOR	0.6	2ND FLOOR
1365049	ELEV 2	OUTSIDE OVER DOOR	0.5	4TH FLOOR
1365055	ELEV 2	OUTSIDE OVER DOOR	0.4	3RD FLOOR
1365070	ELEV 2	OUTSIDE OVER DOOR	0.1	5TH FLOOR
1365080	ELEV 3	OUTSIDE OVER DOOR	0.5	3RD FLOOR
1365066	ELEV 4	OVER DOOR	0.3	5TH FLOOR
1365623	FRGHT ELEV	BACK LEFT CORNER	0.3	BASEMENT
1365054	HALLWAY	ABOVE DOOR ROOM #235	0.6	2ND FLOOR
1365664	HALLWAY	ABOVE DOOR TO RM 34	0.4	BASEMENT
1365656	HALLWAY	ABOVE DOOR TO RM 41	0.6	BASEMENT
1365032	HALLWAY	OVER DOOR #535	0.3	5TH FLOOR
1365088	HALLWAY	OVER DOOR ROOM #269	0.7	2ND FLOOR
1365026	HALLWAY	OVER DOOR ROOM #333	0.3	3RD FLOOR
1365059	HALLWAY	OVER DOOR ROOM #433	0.7	4TH FLOOR
1365028	HALLWAY	OVER DOOR ROOM '235'	0.6	2ND FLOOR-DUPLICATE
1365090	HALLWAY	WINDOW SILL NEAR RM 15	0.1	BASEMENT
1365076	MAIL M	MEN'S CHANGE RM LOCKER #282	0.1	1ST FLOOR
1365085	MAIL RM	BREAK ROOM TOP OF REFRIGERATOR	0.2	1ST FLOOR
1365209	MAIL RM	CAGE BY FREIGHT ELEVATOR	0.2	1ST FLOOR
1365075	MAIL RM	COLUMN 49	0.4	1ST FLOOR
1365197	MAIL RM	COLUMN 68 ON ELECT BOX	0.2	1ST FLOOR
1365044	MAIL RM	COLUMN 98 ON WOODEN SHELF	0.4	1ST FLOOR
1365064	MAIL RM	ELECT BOX COLUMN 102	0.3	1ST FLOOR
1365048	MAIL RM	EXIT SIGN COLUMN 157	0.1	1ST FLOOR
1365065	MAIL RM	LIGHT SWITCH BTW COL 136& DOOR	0.5	1ST FLOOR
1365050	MAIL RM	LIGHT SWITCH COLUMN 114	0.4	1ST FLOOR
1365086	MAIL RM	LIGHT SWITCH COLUMN 117	0.4	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS DALLAS, TX
BRYAN & ERVAY STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365094	MAIL RM	LIGHT SWITCH COLUMN 145	0.6	1ST FLOOR
1365092	MAIL RM	LIGHT SWITCH COLUMN 148	0.4	1ST FLOOR
1365072	MAIL RM	LIGHT SWITCH COLUMN 158	0.2	1ST FLOOR
1365074	MAIL RM	LIGHT SWITCH NEAR DOOR #127	0.4	1ST FLOOR
1365034	MAIL RM	LOCKER #285 BTW COL 160-161	0.1	1ST FLOOR
1365202	MAIL RM	MEN'S CHANGE RM LOCKER #211	0.4	1ST FLOOR
1365046	MAIL RM	MEN'S CHANGE RM LOCKER #273	0.2	1ST FLOOR
1365231	MAIL RM	MEN'S CHANGE RM ON LEFT LOCKER	0.2	1ST FLOOR
1365084	MAIL RM	MEN'S CHANGE RM ON LOCKER #338	0.1	1ST FLOOR
1365035	MAIL RM	MEN'S CHANGE RM ON RT LOCKER	0.3	1ST FLOOR
1365057	MAIL RM	METAL SUPPLY CABINET COL 89	0.6	1ST FLOOR
1365040	MAIL RM	ON COLUMN 126	0.4	1ST FLOOR
1365093	MAIL RM	OVER PIGEON HOLE #214001/FRASE	0.2	1ST FLOOR
1365058	MAIL RM	OVER PIGEON HOLE #21457/DURAN	0.2	1ST FLOOR
1365078	MAIL RM	PIGEON HOLE BTW COL 161-147	0.1	1ST FLOOR
1365174	MAIL RM	PIGEON HOLE BTW COL 161-147	0.1	1ST FLOOR-DUPLICATE
1365087	MAIL RM	PIGEON HOLE COLUMN 148	0.2	1ST FLOOR
1365210	MAIL RM	PIGEON HOLE NEAR COLUMN 128	0.5	1ST FLOOR
1365073	MAIL RM	STAMP VENDING MACHINE COL 72	0.3	1ST FLOOR-DUPLICATE
1365096	MAIL RM	STAMP VENDING MACHINE COL 72	0.4	1ST FLOOR
1365053	MAIL RM	STATION 224 TOP PIGEON HOLE	0.5	1ST FLOOR
1365069	MAIL RM	TOP ELECT BOX COLUMN 77	0.2	1ST FLOOR
1365038	MAIL RM	TOP FIRST AID COLUMM 119	0.1	1ST FLOOR
1365039	MAIL RM	TOP LEDGE CORNER #29	0.6	1ST FLOOR
1365200	MAIL RM	TOP LOST & FOUND COLUMN 75	0.7	1ST FLOOR
1365031	MAIL RM	TOP METAL CABINET COLUMN 106	0.4	1ST FLOOR
1365082	MAIL RM	TOP METAL SHELF 'G' COLUMN 86	0.2	1ST FLOOR
1365063	MAIL RM	TOP METAL SHELVES COLUMN 92	0.7	1ST FLOOR
1365228	MAIL RM	TOP PIGEON HOLE STATION #9	0.4	1ST FLOOR
1365077	MAIL RM	TOP SHELF COLUMN 132	0.4	1ST FLOOR
1365194	MAIL RM	TOP SHELF COLUMN 132	0.4	1ST FLOOR-DUPLIATE
1365186	MAIL RM	TOP SHELF COLUMN 150	0.3	1ST FLOOR
1365226	MAIL RM	WINDOW SILL BEHIND COLUMN 163	0.1	1ST FLOOR
1365666	MEN'S RM	TOP OF TOWEL DISPENSER	0.9	BASEMENT
1365657	STAIRWELL	BOTTOM OF STAIRS IN CUP	0.8	BASEMENT
1365229	STAIRWELL	IN CUP IN STAIRWELL	0.3	1ST FLOOR
1365097	STAIRWELL	OVER DOOR "3"	0.7	3RD FLOOR
1365061	STAIRWELL	OVER DOOR '1'	0.5	1ST FLOOR
1365091	STAIRWELL	OVER DOOR '1'	1.1	1ST FLOOR
1365041	STAIRWELL	OVER DOOR '2'	1.0	2ND FLOOR
1365036	STAIRWELL	OVER DOOR '3'	0.5	3RD FLOOR
1365045	STAIRWELL	OVER DOOR '3'	0.6	3RD FLOOR
1365030	STAIRWELL	OVER DOOR '4'	0.2	4TH FLOOR
1365083	STAIRWELL	OVER DOOR '4'	0.9	4TH FLOOR
1365027	STAIRWELL	OVER DOOR '5'	0.2	5TH FLOOR
1365067	STAIRWELL	OVER DOOR '5'	0.8	5TH FLOOR
1365658	STORAGE	EMERG LIGHT COLUMN ACROSS RM54	0.4	BASEMENT
1365667	STORAGE	OFF BOILER LEFT BREAKER BX	0.8	BASEMENT
1365613	STORAGE	OFF WORKSHOP ON EMERG LIGHT	1.1	BASEMENT
1365636	STORAGE	OFF WORKSHOP RED LIGHT SWITCH	0.7	BASEMENT
1365620	STORAGE	OFF WORKSHOP TOP YELLOW CABINE	0.8	BASEMENT
1365630	STORAGE	TOP DUCT NEAR EYE WASH	0.3	BASEMENT-NEAR RM 54

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS DALLAS, TX
BRYAN & ERVAY STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365729	STORAGE	TOP DUCT NEAR EYE WASH	0.6	BASEMENT-DUPLICATE
1365621	STORAGE	TRANE CONTROL ACROSS FRM RM 57	0.4	BASEMENT
1365676	STOREAGE	OFF BOILER RM BREAKER BOX BACK	0.6	BASEMENT
1365640	WOMEN'S RM	CUP ON FLOOR	0.9	BASEMENT
1365645	WOMEN'S RM	ON TOWEL DISPENSER	1.0	BASEMENT
1365708	WOMEN'S RM	ON TOWEL DISPENSER	0.1	BASEMENT
1365663	WORK SHOP	BLACK BOX BACK WALL	0.8	BASEMENT
1365677	WORK SHOP	TOP METAL CABINET LEFT WALL	0.6	BASEMENT
1365615	WORK SHOP	TOP METAL CEBINET	0.6	BASEMENT
1365641	WORK SHOP	TOP OF METAL CABINET	0.6	BASEMENT-DUPLICATE

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS DEMING, NM
201 WEST SPRUCE

Detector ID#	Room #	Location	PCi/L	Comments
1366057		TRAVEL BLANK	0.1	TRAVEL BLANK
1366350	126	METAL CABINET NEXT TO CLOCK	0.4	1ST FLOOR 1965 CONSTRUCTION
1366378	129	TOP OF LOCKER #16	1.6	1ST FLOOR 1965 CONSTRUCTION
1366319	130	ON BLUE CABINET	2.4	1ST FLOOR 1965 CONSTRUCTION
1366031	131	MEN'S ROOM ABOVE MIRROR	2.2	1ST FLOOR 1965 CONSTRUCTION
1366317	131	ON FLOOR IN CUP	2.9	1ST FLOOR 1965 CONSTRUCTION
1366344	132	ON FLOOR IN CUP	2.7	DUPLICATE
1366347	132	ON FLOOR IN CUP	2.7	1ST FLOOR 1965 CONSTRUCTION
1366301	BOILER RM	WOODEN SHELF BY ELECT BOX	2.4	1ST FLOOR 1965 CONSTRUCTION
1366345	CONF ROOM	ON FILE CABINET	2.3	1ST FLOOR 1965 CONSTRUCTION
1366348	JUNK ROOM	ON CARBOARD BOX	2.7	[CONTINUOUS MONITOR]
1366309	LADDER RM	ON RT WALL	1.8	BASEMENT [CONTINUOUS MONITOR]
1366308	LG STORERM	BLUE SHELF RIGHT SIDE	2.1	1ST FLOOR 1965 CONSTRUCTION
1366369	LG STORERM	WOODEN SHELF LEFT SIDE	2.8	BASEMENT DUPLICATE
1366297	LG STORERM	WOODEN SHELF ON LEFT SIDE	2.8	BASEMENT
1366375	MAIL RM	FAR BACK CORNER PIGEON HOLE	1.3	1ST FLOOR
1366340	MAIL RM	FAR FRONT RT CORNER PIGEON HOL	1.2	1ST FLOOR
1366362	MAIL RM	FRONT LF CORNER NEAR SERV WIND	1.5	1ST FLOOR
1366290	MAIL RM	LF BACK CORNER ABOVE CHALK BRD	1.4	1ST FLOOR
1366359	MAIL RM	MID RM OVER GOOD HOUSEKEEPING	1.1	1ST FLOOR
1366325	MEN'S RM	ON WALL BOTTOM OF STAIRWELL	1.0	1ST FLOOR
1366330	MEN'S RM	TOP OF STAIRS	1.2	1ST FLOOR
1366284	SHOP	ON SHELF NEXT TO FAN	2.1	BASEMENT
1366004	STAIRWELL	BOTTOM OF STAIRS	2.1	1ST FLOOR 1965 CONSTRUCTION
1366327	STAIRWELL	BOTTOM OF STAIRS	2.4	BASEMENT
1366376	STAIRWELL	BOTTOM OF STAIRS OFF LOBBY	2.4	1ST FLOOR 1965 CONSTRUCTION
1366018	STAIRWELL	TOP OF STAIRS	2.1	2ND FLOOR 1965 CONSTRUCTION
1366342	STAIRWELL	TOP OF STAIRS 2ND FLOOR	2.7	2ND FLOOR 1965 CONSTRUCTION
1366366	STAIRWELL	TOP OF STAIRS TO BASEMENT	2.0	1ST FLOOR
1366343	STORE RM	ON WOD CABINET TO LEFT	2.3	1ST FLOOR 1965 CONSTRUCTION
1366267	STORE RM	RM W/TYPEWRITER ON OAK SHELF	2.0	BASEMENT
1366296	SUPPLY RM	ON METAL CABINET	3.0	BASEMENT
1366049	VAULT	ON FILE CABINET RT SIDE	1.9	1ST FLOOR
1366298	WOMEN'S RM	BACK ROOM	2.3	1ST FLOOR 1965 CONSTRUCTION
1366367	WOMEN'S RM	FRONT ROOM ABOVE MIRROR	2.2	1ST FLOOR 1965 CONSTRUCTION

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ELDORA, IA
1334 EDGINGTON

Detector ID#	Room #	Location	PCi/L	Comments
1365566		TRAVEL BLANK	0.1	TRAVEL BLANK
1365570		TRAVEL BLANK	0.1	TRAVEL BLANK
1365369	1	TOP OF FILING CABINET	2.3	
1365545	13	WORK AREA ON CABINET	2.0	STATIONARY/PHOTOCOPY ROOM
1365581	14	UNDER SINK ON PIPE	---	MEN'S ROOM [LOST]
1365549	2	SOIL CONSERVATION OFFICE	2.5	ON DARK GREEN CABINET S WALL
1365571	2	SOIL CONSERVATION OFFICE	2.2	DUPLICATE
1365542	3	ISU EXTENSION SERVICE CONF RM	2.4	IN POTTED PLANT
1365547	3	ISU EXTENSION SERVICE CONF RM	1.8	DUPLICATE
1365590	4	OUTSIDE WALL CABINET	2.1	OFFICE
1365575	5	RT SIDE 5' HIGH ON FILE CABINE	1.3	
1365555	6	BY BLUE BOILER UNITS	1.1	BOILER ROOM
1365297	6	UNDER STAIR CASING ON BOX	3.2	STORAGE AREA
1365541	9	EXTENSION CONFERENCE ROOM	1.9	ON BOX BACK RT CORNER

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ELDORA, IA
1334 EDGINTON

Detector ID#	Room #	Location	PCi/L	Comments
1365579	13	WORK AREA/PHOTOCOPY ROOM	1.9	

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS ENID, OK
115 WEST BROADWAY

Detector ID#	Room #	Location	PCi/L	Comments
1366090		TRAVEL BLANK	---	TRAVEL BLANK [OVEREXPOSURE]
1366078	10	ON AIR HANDLER	0.3	BASEMENT
1366099	11	FLOOR ON CUP BEHIND TRASHCAN	0.5	BASEMENT
1366128	13	ON CABINET TO RIGHT	0.3	BASEMENT
1366116	13(307A)	IN SMALL SIDE RM ON VENT	0.2	BASEMENT
1366077	16	ON SHELF TO LEFT ON BACK WALL	0.4	BASEMENT
1366112	16	ON SHELF TO LEFT ON BACK WALL	0.7	BASEMENT-DUPLICATE
1366091	18	ON CABINET	0.2	BASEMENT
1366136	19A,19,17	NEAR COFFEE POT	0.1	BASEMENT
1366104	1A	ON WALL BACKSIDE OF AIR DUCT	0.3	BASEMENT
1366097	1B	ON METAL BOX	0.3	BASEMENT-DUPLICATE
1366123	1B	ON METAL BOX	0.1	BASEMENT
1366109	23	PIGEON HOLE	0.3	BASEMENT
1366120	25	MEN'S ROOM ON WALL	0.6	BASEMENT
1366075	26	IN SIDE DOOR ON SHELF	0.1	BASEMENT
1366092	26	ON AIR HOLE VENT	0.3	BASEMENT
1366137	28	ON PARTITION WALL	0.2	BASEMENT
1366113	29	TOP OF REFRIGERATOR	0.3	BASEMENT
1366117	3	MEN'S RM ON AIR DUCT	0.4	BASEMENT
1366139	30	ON CATALOG SHELF	0.4	BASEMENT
1366133	30	ON DESK NEAR XMAS TREE	0.7	BASEMENT
1366094	30	ON MAIL BOXES	0.4	BASEMENT
1366076	32	ON SHELF OF SUPPLY CABINET	0.2	BASEMENT
1366101	33	ON TABLE	1.0	BASEMENT
1366087	34	ON METAL SHELF NEXT FY90 BOX	0.1	BASEMENT
1366100	34	ON METAL SHELF NEXT FY90 BOX	0.3	BASEMENT-DUPLICATE
1366074	36	ON FLUE	0.2	BASEMENT
1366102	37	ON WOOD SHELF	---	BASEMENT [NO DATA]
1366068	4	ON WALL	0.4	BASEMENT
1366111	4	ON WALL	0.7	BASEMENT-DUPLICATE
1366108	40	ON METAL SHELF NEXT TO TROPHY	0.1	BASEMENT
1366135	41	ON EMERGENCY LIGHT	0.4	BASEMENT
1366096	42	ON SHELF	0.2	BASEMENT
1366121	5	WOMEN'S RM ON TOWEL RACK	0.2	BASEMENT
1366439	51	FLOOR ON CUP	0.4	BASEMENT
1366079	7	ON MICROWAVE	0.4	BASEMENT
1366069	ELEVATOR	INSIDE LIGHT	0.1	BASEMENT
1366106	HALLWAY	NEXT TO RM 14 ON ELECT BOX	0.2	BASEMENT
1366084	HALLWAY	ON ALARM SYS NEXT TO PANEL 115	0.2	BASEMENT
1366125	HALLWAY	ON BOX NEXT TO EXIT DOOR	0.1	BASEMENT
1366174	LOBBY	1ST FLOOR ABOVE ELEVATOR DOOR	0.3	1ST FLOOR
1366086	LOBBY	2ND FLOOR ABOVE ELEVATOR DOOR	0.1	2ND FLOOR
1366157	LOBBY	3RD FLOOR ABOVE ELEVATOR DOOR	0.2	3RD FLOOR
1366132	MAIL SORT	ABOVE COFFEE MUGS	0.2	1ST FLOOR
1366122	MAIL SORT	ABOVE STAMP MACHINE	0.2	1ST FLOOR
1366119	MAIL SORT	ELECT BOX NEAR WOMEN'S ROOM	0.3	1ST FLOOR
1366088	MAIL SORT	FIRST AID SHELF NEAR MEN'S RM	0.2	1ST FLOOR
1366127	MAIL SORT	ON TOP OF COKE MACHINE	---	1ST FLOOR [NO DATA]
1366134	NEAR ELEV	ON EMERGENCY LIGHT	0.1	BASEMENT
1366080	STAIRWELL	BY SWING RM TOP EMERG LIGHT	0.5	BASEMENT
1366081	STAIRWELL	NEXT TO RM 7 ON WALL	0.1	BASEMENT
1366126	SUPPLY	POSTAL SUPPLY RM	0.3	BASEMENT

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Martin Marietta Energy Systems
USPS ENID, OK
115 WEST BROADWAY

Detector ID#	Room #	Location	PCi/L	Comments
1366105	SUPPLY	POSTAL SUPPLY ROOM	0.1	BASEMENT-DUPLICATE

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS HOPE, AR
2ND & LAUREL STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365175		NAVY RETRUITING FILE CABINET	0.1	1ST FLOOR
1365173	110	SS OFFICE ON TABLE	0.4	1ST FLOOR
1365222	110	SS OFFICE RT ROOM ON PARTITION	0.2	1ST FLOOR
1365217	112	CLOSET CRAWLSPACE	1.6	1ST FLOOR
1365192	112	IN CLOSET ON SWITCH BOX	0.2	1ST FLOOR
1365071	112	ON PICTURE	0.2	1ST FLOOR
1365212	128	A&D LEFT RM ON FILE CABINET	0.1	1ST FLOOR
1365068	128	A&D ON CHALK BOARD	0.1	1ST FLOOR-ALCOHOL & DRUG ABUSE
1365227	128	A&D RT ROOM ON FILE CABINET	0.4	1ST FLOOR
1365182	COLLECTION	ON PIGEON HOLE	0.1	1ST FLOOR
1365180	HALLWAY	ON DIRECTORY	0.1	1ST FLOOR
1365213	MAIL RM	HALLWAY PO BOXES ELECT BOX	0.1	1ST FLOOR
1365189	MAIL RM	ON RURAL 1 SHELF	0.1	1ST FLOOR
1365214	MAIL RM	ON SHELF ABOVE STATION #2	0.4	1ST FLOOR
1365047	MAIL RM	ON SHELF C-3	0.4	1ST FLOOR-DUPLICATE
1365184	MAIL RM	ON SHELF C-3	0.5	1ST FLOOR
1365223	MAIL RM	ON SHELF FOR ROUTE 3	0.3	1ST FLOOR
1365206	MAIL RM	TOP OF ACCOUNTABLES CABINET	0.1	1ST FLOOR
1365234	MAIL RM	TOP OF CABINET B402802	0.1	1ST FLOOR
1365233	MAIL ROOM	BASE OF STEEL COLUMN	0.3	1ST FLOOR
1365177	MEN'S RM	ON AIR FRESHNER	0.3	1ST FLOOR
1365220	MEN'S RM	ON AIR FRESHNER	0.4	1ST FLOOR
1365170	MIAL RM	SECTION SECTION PO BOXES	0.2	1ST FLOOR
1365052	MOP ROOM	ON SHELF	0.4	1ST FLOOR
1365187	PIPE CHASE	OUTSIDE DOOR ON RT ELECT BOX	0.8	1ST FLOOR
1365190	PIPE CHASE	OUTSIDE DOOR ON RT ELECT BOX	0.5	1ST FLOOR-DUPLICATE
1365207	PM BATH	TOP OF MIRROR	0.1	1ST FLOOR
1365240	PM OFFICE	ON THERMOSTAT	0.1	1ST FLOOR
1365179	RM 112	ARMY RECRUITING ROOM 1 LEFT	0.4	1ST FLOOR
1365218	ROOM 112	ARMY RECRUITING ROOM 2 LEFT	0.1	1ST FLOOR
1365081	STORAGE	CRAWL SPACE 'OFFICE SUPPLIES'	0.8	1ST FLOOR
1365201	STORAGE	CUP ON FLOOR	0.3	1ST FLOOR
1365241	STORAGE	ON METAL CART BACK WALL	0.2	1ST FLOOR
1365191	STORAGE	TOP OF SHELF	0.3	1ST FLOOR
1365172	STORAGE	TOP OF SHELF B308601	0.3	1ST FLOOR-OFFICE SUPPLIES
1365181	STPRAGE	CRAWL SPACE	1.0	1ST FLOOR DUPLICATE
1365219	SUPR OFF	ON TIME SWITCH FRONT WALL	0.6	1ST FLOOR
1365203	SWING ROOM	ON LOCKER #7	0.1	1ST FLOOR
1365199	VAULT	ON SHELF LEFT WALL	0.5	1ST FLOOR
1365193	WOMEN'S RM	ON AIR FRESHNER	0.3	1ST FLOOR
1365185	WOMEN'S RM	ON ROOM FRESHER	0.3	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS HOPE, AR
3RD & LAUREL STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1365224		TRAVEL BLANK	0.1	TRAVEL BLANK
1365230	MAINT RM	ON LOCKER #3	0.4	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS JEFFERSON CITY, MO
631 WEST MAIN STREET

Detector ID#	Room #	Location	PCi/L	Comments
1365701		RM OUTSIDE WOMEN'S RM ON FLOOR	0.6	
1365685		TRAVEL BLANK	0.1	TRAVEL BLANK
1365699		TRAVEL BLANK	0.2	TRAVEL BLANK
1365705		TRAVEL BLANK	---	NO EXPOSURE DATA
1365361	3RD FLOOR	AIR HANDLER ON DUCT	0.5	
1365693	AIR HAND2	TOP OF ELECTRIC BOX	2.0	
1365334	ATTIC	AIR HANDLER	0.6	
1365362	ATTIC	ELEVATOR MECHANICAL ROOM	0.3	
1365384	ATTIC	TOP OF ELECTRICAL BOX	0.3	
1365270	BOILER RM	LOWER LEVEL ON CABINET	3.0	
1365275	BOILER RM	UPPPER LEVEL ON ELECT BOX	1.1	
1365291	ELEVATOR	INSIDE ON LIGHT PANEL	0.1	
1365242	ELEVATOR	OUTISDE OF ELEVATOR	0.8	BASEMENT - MAIN ELEVATOR
1365330	ELEVATOR	OUTSIDE ELEVATOR	0.7	3RD FLOOR
1365363	ELEVATOR	OUTSIDE ELEVATOR	1.0	2ND FLOOR
1365339	LOCKER RM	ON LOCKER CENTER OF RM	0.9	
1365267	MAIL RM	AIR HANDLER RM ON AIR DUCT	1.1	
1365349	MAIL RM	BY ELEVATOR	1.0	
1365315	MAIL RM	FAR RIGHT WALL	0.9	
1365706	MAIL RM	IN FREIGHT ELEVATOR	0.8	
1365331	MAIL RM	ON CONTROL PANEL OF ELEVATOR	1.1	
1365382	MAIL RM	STAIRWELL	0.8	
1365245	MAIL RM	TOP OF LIGHT	0.7	
1365344	MAIL SORT	1ST FLOOR	---	NO EXPOSURE DATA
1365303	MAIL SORT	NEAR FREIGHT ELEVATOR	---	NO EXPOSURE DATA
1365306	MAIL SORT	ON EMERGENCY LIGHT IN BACK	1.1	NO EXPOSURE DATA
1365246	MAINT	SUPPLY & RECORDS ON KEY BOX	1.7	
1365307	SHOWER RM	BATHROOM ON WALL	0.8	
1365347	STAIRWELL	NEAR MAINT RM ON EMERG LIGHT	1.1	
1365333	SUPPLY RM	CASE LIGHT #30	1.2	
1365318	SUPPLY RMN	TOP OF CABINET	1.4	
1365316	SWING RM	TOP OF COKE MACHINE	1.1	
1365690	SWING RM	TOP OF COKE MACHINE	1.1	DUPLICATE
1365350	VAULT	ON VAULT	---	1ST FLOOR [LOST]
1365311	WOMEN'S RM	TOP OF LOCKER #78	---	DUPLICATE - LOST
1365357	WOMEN'S RM	TOP OF LOCKER #78	1.2	

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS OKMULGEE, OK
4TH & MORTON STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1366148	10	TOP OF TOOL SHELVES	5.0	BASEMENT
1366152	10	TOP OF TOOL SHELVES	3.6	BASEMENT-DUPLICATE
1366153	11	NEAR CLOCK	0.1	BASEMENT
1366151	11	ON LOCKER #37	0.4	BASEMENT
1366149	12	TOP OF FILE CABINET	0.4	BASEMENT
1366158	14	ON RADIATOR	0.9	BASEMENT
1366173	14	ON RADIATOR	0.1	BASEMENT-DUPLICATE
1366205	15	TOP OF PHONE BOX	---	BASEMENT [NO DATA]
1366146	16	TOP OF RADIATOR	0.1	BASEMENT
1366143	17	ON FILE CABINET	0.2	BASEMENT
1366177	17	ON FILE CABINET	0.4	BASEMENT-DUPLICATE
1366187	18	ON TABLE	0.1	BASEMENT
1366178	19-VAULT	TOP OF FAN	3.5	BASEMENT
1366190	20-VAULT	TOP OF METAL CABINET	4.9	BASEMENT
1366176	21	MEN'S ROOM - TOWEL DISPENSER	0.7	BASEMENT
1366156	22	WOMEN'S ROOM TOWEL DISPENSER	---	BASEMENT [NO DATA]
1366175	22	WOMEN'S ROOM TOWEL DISPENSER	0.1	BASEMENT-DUPLICATE
1366085	23	ON SHELF	0.9	BASEMENT
1366202	24	ON BEAM IN BACK CLOSET	---	BASEMENT [NO DATA]
1366144	3	MEN'S ROOM CENTER RM ON PIPES	0.4	BASEMENT
1366165	5	NEAR COFFEE POT	0.8	BASEMENT SWING ROOM
1366184	7	ON CABINET NEXT TO TYPEWRITER	0.3	BASEMENT
1366140	9	NEAR PUNKINS ON SHELF	1.8	BASEMENT
1366208	BATHROOM	TOWEL DISPENSER	0.2	BASEMENT
1366186	ELEVATOR	IN LOWERED CEILING	0.3	BASEMENT
1366181	HALLWAY	ON MECHANICAL BLOWER	1.4	COMPARE TO 1366200 RESULT BSMT
1366161	HALLWAY	OUTSIDE RM 9 ON FIRE EXTING.	0.5	BASEMENT
1366155	MAIL ROOM	ON CABINET	1.3	BASEMENT
1366203	SORT RM	ELECTRICAL BOX NEAR BACK	0.1	1ST FLOOR
1366159	SORT RM	ON BULLETIN BOARD NEAR BACK	0.1	1ST FLOOR
1366194	SORT RM	ON CABINET NEAR WOMEN'S ROOM	0.1	1ST FLOOR
1366163	STAIRWELL	LEFT OF ELEVATOR	0.1	BASEMENT
1366200	SUCTION FN	LEDGE UNDER DOCK	7.5	BASEMENT
1366193	SWING ROOM	ON LOCKER	0.2	BASEMENT

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS OKMULGEE, OK
4TH & NORTON STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1366168	MAIL ROOM	TRAVEL BLANK	0.1	TRAVEL BLANK

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS PECOS, TX
4TH & OAK STREETS

Detector ID#	Room #	Location	PCi/L	Comments
1366278	2ND LOBBY	EMERGENCY LIGHT ELEVATOR LOBBY	0.1	2ND FLOOR
1366229	3	ON LOCKER BOX #4	1.5	BASEMENT [CONTINUOUS MONHITOR]
1366274	4	SHOP BACK OF ROOM ON SHELF	0.9	BASEMENT
1366250	4	TOP OF LOCKER NEXT TO HOSE	0.9	BASEMENT
1366287	7	TOP OF ITT BOX	1.0	BASEMENT [CONTINUOUS MONITOR]
1366226	8	GREEN METAL SHELF BACK LF CORN	3.0	BASEMENT
1366252	8	GREEN METAL SHELF LF CORNER	2.8	BASEMENT DUPLICATE
1366238	BATHROOM	TOP OF AIR DUCT	1.2	OVER CRAWLSPACE
1366216	BOILER RM	LEDGE NEXT TO SINK	1.0	BASEMENT
1366258	BOILER RM	ON ELECTRICAL BOX	1.2	BASEMENT-WINDOW OPEN
1366249	BY ELEV	ON TOP OF LOBBY DIRECTORY	0.4	1ST FLOOR
1366368	CRAWLSPACE	LEFT CORNER	1.0	UNEXCAVTED AREA
1366217	CRAWLSPACE	RT HAND CORNER	0.9	UNEXCAVTED AREA
1366257	ELEV LOBBY	3RD FLOOR BACK OF EXIT SIGN	0.2	3RD FLOOR
1366281	ELEV SHAFT	CUP ON FLOOR	0.6	BASEMENT
1366222	ELEVATOR	LEFT SIDE LEFT SHELF	0.4	1ST FLOOR AND UP
1366270	HALLWAY	TOP OF EMERGENCY LIGHT	1.0	BASEMENT
1366254	MAIL RM	LF SIDE COUNTER PIGEON HOLE	0.2	1ST FLOOR
1366253	MAIL RM	RT SIDE ON WOODEN CABINET	0.4	1ST FLOOR
1366239	MAIL RM	TOP OF FIRST AID KIT	0.1	1ST FLOOR NEAR BASEMENT DOOR
1366218	PO SUPPLY	METAL SHELF NXT TO RUBBER BAND	0.9	OVER CRAWLSPACE
1366228	STAIRWELL	2ND FLOOR BOTTOM OF STAIRS	0.1	STAIRS TO JURY ROOM
1366363	STAIRWELL	2ND FLOOR BOTTOM OF STAIRS	0.2	2ND FLOOR DUPLICATE
1366265	STAIRWELL	BOTTOM OF STAIRS	1.1	BASEMENT
1366262	STAIRWELL	BOTTOM OF STAIRS TO ATTIC	0.3	3RD FLOOR
1366240	STAIRWELL	ON LEDGE AT BOTTOM	0.7	OVER CRAWLSPACE
1366266	STAIRWELL	TOP OF FILE CABINET	0.8	OVER CRAWLSPACE
1366299	STAIRWELL	TOP OF STAIRS AT ELEV SHAFT	0.2	STAIRS TO ATTIC
1366273	STAIRWELL	TOP OF STAIRS TO JURY ROOM	0.1	2ND FLOOR
1366251	STAIRWELL	TOP SIDE OF LIGHT	0.8	BASEMENT
1366214	VAULT	ON SHELF	1.0	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS PUEBLO, CO
421 MAIN STREET

Detector ID#	Room #	Location	PCi/L	Comments
1366042		TRAVEL BLANK	0.1	TRAVEL BLANK
1366055	12	ON GREEN LOCKER	1.0	BASEMENT
1366039	13	BOILER ROOM ON METAL CABINET	1.2	BASEMENT
1366023	13	BOILER ROOM WALL OVER BLACK BX	1.0	BASEMENT
1366016	14	ON TOP OF 7UP MACHINE	1.2	BASEMENT
1366044	19	TOP OF LOCKER #10	1.0	BASEMENT
1366030	19 VAULT	ON SHELF	0.8	BASEMENT
1366053	20	ON RED CABINET	1.1	BASEMENT
1366011	20	THRU RM 22 ABOVE ELEV DOOR	0.9	BASEMENT CONT MONITOR HERE
1366002	22	ON BACK WALL FROM DOOR	6.1	BASEMENT
1366008	23	ON TOP OF LOCKER #5	1.4	BASEMENT
1366043	25	ON WALL RT OF ENTRANCE	1.1	BASEMENT -CONT MONITOR HERE
1366003	2ND FLOOR	ABOVE ELEVATOR DOOR	1.6	2ND FLOOR
1366038	3RD FLOOR	ABOVE ELEVATOR DOOR	1.5	3RD FLOOR
1366063	3RD FLOOR	ABOVE ELEVATOR DOOR	1.0	3RD FLOOR DUPLICATE
1366029	4	ABOVE DOOR	1.8	BASEMENT -DUPLICATE
1366046	4	ABOVE DOOR	1.7	BASEMENT
1366010	4TH FLOOR	ABOVE ELEVATOR DOOR	1.0	4TH FLOOR
1366054	9	ABOVE LIGHT SWITCH ON PILLAR	1.3	BASEMENT
1366059	BATHROOM	ON WALL ABOVE COAT RACK	2.0	BASEMENT - CUSTODIAL BATHROOM
1366015	ELEVATOR	1ST FLOOR ABOVE DOOR	1.2	1ST FLOOR
1365998	ELEVATOR	ON WALL OF ELEVATOR	2.2	BASEMENT
1366009	HALL	ON WOOD CABINET	2.2	BASEMENT
1366026	HALLWAY	TOP OF LOCKER #87	1.7	BASEMENT
1366066	LIFT	ON BLUE SHELF	5.6	BASEMENT-FREIGHT ELEVATOR
1366035	MAIL RM	METAL CABINET BACK RT CORNER	1.4	1ST FLOOR
1366006	MAIL RM	METAL CABINET CENTER OF RM	1.3	1ST FLOOR
1366050	MAIL RM	METAL SHELF BY SERVICE WINDOW	1.1	1ST FLOOR
1366012	MAIL RM	ON SAFE #3 RT SIDE	1.5	1ST FLOOR
1366034	MAIL RM	ON WALL IN BACK CORNER	1.5	1ST FLOOR
1366007	MAIL RM	TOP OF PIGEON HOLE IN CORNER	1.0	1ST FLOOR
1366058	MEN'S RM	ABOVE MIRROR ON WALL	1.1	BASEMENT
1366051	NEAR RM 2	WOODEN CABINET OUTSIDE RM 2	1.5	BASEMENT
1366036	STAIRWELL	TOP OF STAIRS TO SWING RM	1.2	BASEMENT
1366040	STORE RM	ON CABINET RM NEXT TO 7UP MACH	0.9	BASEMENT
1366032	SWING RM	ABOVE LOCKER #976	1.7	BASEMENT
1366067	SWING RM	ABOVE LOCKER 18 [KRACOVEC]	2.1	BASEMENT

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS RATON, NM
SOUTH PARK & 3RD AVE

Detector ID#	Room #	Location	PCi/L	Comments
1366289		TRAVEL BLANK	0.1	TRAVEL BLANK
1366024	103	ON TABLE	0.7	CONTINUOUS MONITOR PLACED HERE
1366048	105	ON WINDOW SILL	0.7	1ST FLOOR
1366014	107	ON WINDOW SILL	0.5	1ST FLOOR
1366358	109	ON WINDOW SILL	0.7	1ST FLOOR
1366352	110	WALL ABOVE MIRROR	0.2	1ST FLOOR MEN'S ROOM
1366346	111	ON RIGHT SIDE SHELF	0.5	1ST FLOOR OCCUPIED OFFICE
1366351	112	ON SHELF	0.5	1ST FLOOR JANITOR'S CLOSET
1366279	113	ON LEFT WALL	1.6	1ST FLOOR
1366365	114	ON WALL ABOVE MIRROR	0.4	1ST FLOOR WOMEN'S ROOM
1366354	115	ON WOODEN CABINET	0.9	1ST FLOOR EQUIPMENT ROOM
1366064	127	ON BOOKCASE	0.0	SUPERVISOR'S OFFICE [NO DATA]
1366013	128	ON BOOKCASE	0.8	1ST FLOOR POST MASTER'S OFFICE
1366000	ADJ 103	ON CUP ON FLOOR 'CLOSET'	0.8	1ST FLOOR
1366033	ADJ 109	ON WINDOW SILL	0.5	1ST FLOOR
1366019	BATHROOM	ON WALL	0.7	1ST FLOOR POSTMASTER'S BATHRM
1366021	BATHROOM	WALL ABOVE MIRROR	0.4	1ST FLOOR NEXT TO SWING ROOM
1366045	CLOSET	ON SHELF	0.3	1ST FLOOR POST MASTER'S OFFICE
1366025	CLOSET	SHELF BEHIND CLEANING SUPPLIES	0.3	1ST FLOOR
1365850	CONF RM	ON SHELF	0.4	1ST FLOOR-DUPLICATE
1366061	CONF RM	ON SHELF	0.1	1ST FLOOR
1365997	HALLWAY	BY EMERGENCY LIGHT	0.7	FEDERAL OFFICE SIDE OF BLDG
1365996	HALLWAY	TOP OF PO BOXES	0.5	1ST FLOOR
1366028	HALLWAY	TOP OF PO BOXES	0.4	1ST FLOOR-DUPLICATE
1366060	MAIL RM	METAL CABINET CENTER OF ROOM	0.4	1ST FLOOR
1366020	MAIL RM	RT CORNER TOP OF PIGEON HOLE	0.2	1ST FLOOR
1366056	MAIL RM	TOP OF GREEN SUPPLY CABINET	0.4	1ST FLOOR
1366022	MAINT RM	TOP OF BLACK METAL SHELF	0.5	1ST FLOOR
1366360	STAIRWELL	BOTTOM OF STAIRWELL	0.9	1ST FLOOR
1366263	STAIRWELL	TOP OF STAIRWELL	0.6	1ST FLOOR
1366052	STORE RM	ABOVE ENTRANCE WAY	0.2	CONTINUOUS MONITOR HERE
1366027	SUPPLY RM	TOP OF WOODEN CABINET	0.5	1ST FLOOR
1366041	SWING RM	TOP OF LOCKER 13	0.4	1ST FLOOR
1366001	VAULT	ON WOODEN CABINET	1.3	1ST FLOOR
1366047	WOMEN'S RM	TOP OF LOCKERS	0.1	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS SCOTT CITY, KS
211 WEST MAIN STREET

Detector ID#	Room #	Location	PCi/L	Comments
1366098	106	WINDOW SILL	0.8	1ST FLOOR-CONFERENCE ROOM
1366129	108	ON BLUE CABINET	0.8	1ST FLOOR-OFFICE
1366114	113	CUP ON FLOOR	1.0	1ST FLOOR-CONSERVATION OFFICE
1366115	114	ON BOOK SHELF	0.7	1ST FLOOR
1366093	116A	ON SHELF NEXT TO PAPER	0.8	1ST FLOOR
1366167	116B	ON FILE CABINET	0.7	1ST FLOOR-CONSERVATION OFFICE
1366082	118	ON FILE CABINET	0.9	1ST FLOOR
1366110	118A	CUP ON FLOOR	0.7	1ST FLOOR
1366180	127	NEXT TO MAIL BOX	0.3	1ST FLOOR-POST MASTER'S OFFICE
1366107	128	ON SHELF	0.6	1ST FLOOR
1366138	128	ON SHELF	0.7	1ST FLOOR-DUPLICATE
1366103	128C	ON WALL	0.3	1ST FLOOR-POSTMASTER'S BATH
1366071	134	ON TOP OF LOCKER #3	0.6	1ST FLOOR-SWING ROOM
1366083	135	WOMEN'S RM WINDOW SILL	0.1	1ST FLOOR
1366164	136	ON METAL SHELF	0.4	1ST FLOOR
1366147	139	TOP OF BLUE FILE CABINET	0.3	1ST FLOOR-STORAGE ROOM
1366124	MAIL RM	BY CACTUS	0.8	1ST FLOOR
1366179	MAIL RM	BY CLOCK/MAIL SLOTS	0.4	1ST FLOOR
1366095	MAIL RM	TOP OF PIGEON HOLE ON RIGHT	0.6	1ST FLOOR
1366118	MAIL ROOM	TRAVEL BLANK	0.1	TRAVEL BLANK
1366195	MEN'S RM	ON WALL	0.3	1ST FLOOR
1366017	PIPE CHASE	ON WALL	0.6	1ST FLOOR
1366062	PIPE CHASE	ON WALL	0.6	1ST FLOOR-DUPLICATE
1366131	STAIRWELL	ON WALL AT BOTTOM OF STAIRS	0.5	1ST FLOOR
1366198	STAIRWELL	ON WALL AT TOP OF STAIRS	0.5	1ST FLOOR
1366070	VAULT	ON CABINET	0.1	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS WACO, TX
800 FRANKLIN

Detector ID#	Room #	Location	PCi/L	Comments
1365732		TRAVEL BLANK	0.1	TRAVEL BLANK
1365748	221	OVER DOOR	0.2	2ND FLOOR
1365752	3	METAL SHEVLES LEFT WALL	1.8	BASEMENT-DUPLICATE
1365762	3	RT WALL TOP METAL SHELVES	1.8	BASEMENT
1365755	4	ON CABINET #3 RT WALL	1.2	BASEMENT
1365415	4	STORAGE CABINET #13 [PAINT RM]	1.5	BASEMENT
1365443	4	TOP OF FIRST AID LEFT WALL	1.2	BASEMENT
1365434	4	WOODEN SHELF PAINT ROOM	1.0	BASEMENT
1365775	5	TOP METAL SHELVES LEFT WALL	1.4	BASEMENT
1365447	5	TOP METAL SHELVES RT WALL	1.4	BASEMENT
1365740	6	ABOVE LIGHT OVER WORKBENCH	1.3	BASEMENT
1365425	8	TOP OF PIGEON HOLE BACK CORNER	---	NO DATA CANISTER NOT SEALED
1365455	8	TOP WOODEN CABINET NXT CLOCK	1.1	BASEMENT
1365404	9	AIR DUCT SECTION F SIGN	2.5	BAEMENT-STORAGE
1365457	9	AIR HANDLER RM METAL SHELF	0.6	BASEMENT
1365438	9	BAC WALL SECTION 'G' CUP FLOOR	2.4	BASEMENT-STORAGE
1365402	9	BLACK AIR DUCT SECTION 'G'	2.3	BASEMENT-STORAGE
1365742	9	BLUE FILE CABINET RT WALL	2.3	BASEMENT -DUPLICATE
1365437	9	BLUE STORAGE (410-499) BACK WL	2.5	BASEMENT-STORAGE
1365419	9	CUP FLOOR NEXT TO SANITATION	3.0	BASEMENT-STORAGE
1365414	9	CUP ON FLOOR BACK RT CORNER	3.0	BASEMENT-STORAGE
1365716	9	FAR LEFT CORNER ON TABLE	2.4	BASEMENT
1365399	9	LT CORNER THRU DOOR CUP ON FLR	2.4	BAESMENT-STORAGE
1365768	9	ON AIR DUCT MEI02	2.8	BASEMENT-STORAGE
1365428	9	ON ELECT BOX COLUMN B-10	2.4	BASEMENT-STORAGE
1365709	9	ON ELECT BOX RT HAND WALL	2.5	BASEMENT-STORAGE
1365388	9	RT HAND WALL ON FILE CABINET	2.2	BASEMENT
1365422	9	SHELF OVER WORK BENCH	2.7	BASEMENT-STORAGE
1365776	9	WOOD RACK BEHIND BLOCK WALL	2.4	BASEMENT-STORAGE
1365451	9	YELLOW BOX AIR HANDLER ROOM	1.3	BASEMENT
1365418	AIR HANDLE	METAL SHELF	2.4	BASEMENT
1365411	BOILER RM	BOILER ROOM ELECT BOX RT WALL	1.1	BASEMENT
1365733	BOILER RM	ON EMERGENCY LIGHT [DUP]	1.1	BASEMENT-DUPLICATE
1365720	BOILER RM	TOP OF EMERGENCY LIGHT	1.1	BASEMENT
1365454	BOILER RM	TOP OF FILE CABINET EMERG EXIT	1.1	BASEMENT
1365730	BREAK RM	ON BULLETIN BOARD	0.6	1ST FLOOR
1365769	BREAK RM	ON GRAY STORAGE CABINET	0.6	1ST FLOOR
1365738	BREAK ROOM	ON DR PEPPER MACHINE	0.4	1ST FLOOR
1365724	CHILLER RM	GRAY SHELF BACK WALL	0.9	BASEMENT
1365712	ELEVATOR	MAINT ELEVATOR SWITH CONTROL	1.0	BASEMENT
1365393	ENG MAINT	ON LOCKER #1	1.1	BASEMENT
1365770	HALLWAY	ON LEFT ELECT BOX	1.1	BASEMENT
1365779	HALLWAY	TOP OF BLACK ELECT BOX	1.5	BASEMENT
1365413	JANITOR RM	PAPER TOWEL DISPENSER	2.6	BASEMENT
1365725	LF ELEV	IN LIGHT	0.6	BASEMENT
1365743	MAIL CM	COLUMN 18 SHELF A	0.6	1ST FLOOR
1365761	MAIL RM	ACROSS FRM COLMN CORNER PARTIT	0.6	1ST FLOOR
1365717	MAIL RM	ACROSS FRM COLUMN 9 TOP CORNER	0.4	1ST FLOOR
1365721	MAIL RM	COLUMN 10 SHELF BY FAN	0.6	1ST FLOOR
1365749	MAIL RM	COLUMN 11 SELF BY FAN	0.4	1ST FLOOR
1365741	MAIL RM	COLUMN 13 TOP GREEN PIGEON HOL	0.7	1ST FLOOR
1365774	MAIL RM	COLUMN 16 TOP SHELF BY FAN	0.4	1ST FLOOR

USPS Charcoal Testing Data (1992)
Martin Marietta Energy Systems
USPS WACO, TX
800 FRANKLIN

Detector ID#	Room #	Location	PCi/L	Comments
1365766	MAIL RM	COLUMN 5 DUPLICATE	0.7	BASEMENT-DUPLICATE
1365758	MAIL RM	COLUMN 5 TOP GREEN PIGEON HOLE	0.6	1ST FLOOR
1365744	MAIL RM	COLUMN 7 GRAY CABINET	0.5	1ST FLOOR
1365715	MAIL RM	CORNER BY FAN ACROSS COLMN 16	0.6	1ST FLOOR
1365736	MAIL RM	GREEN CABINET ACROSS FRM VAULT	0.8	1ST FLOOR
1365760	MAIL RM	GREEN CABINET UNDER CLOCK	0.7	1ST FLOOR
1365723	MAIL RM	GREEN SHELF COLUMN 14	0.9	1ST FLOOR
1365756	MAIL RM	ON COLUMN 2 SHELF	0.6	1ST FLOOR
1365714	MAIL RM	ON ELECT BOX NEAR EXIT DOOR	0.6	1ST FLOOR
1365751	MAIL RM	ON LOCKER #205 ACROSS COLMN 17	0.7	1ST FLOOR
1365426	MAINT OFF	ELEVATOR KEY BOX	2.6	BASEMENT
1365450	MAINT OFF	ELEVATOR KEY BOX	0.5	BASEMENT
1365737	MEN'S RM	ON LIGHT AIR VENT	1.5	BASEMENT
1365778	RT ELEV	LEFT SIDE OF LIGHT	0.4	BASEMENT
1365453	SECTION H	ELECT BOX BACK HALL	1.1	BASEMENT
1365444	SECTION H	WINDOW SILL	1.3	BASEMENT
1365754	SECTION H	WINDOW SILL	1.4	BASEMENT-DUPLICATE
1365726	STAIRWELL	BOTTOM ON BLUE SHELF PIPING	0.5	BASEMENT
1365745	STAIRWELL	BOTTOM ON EMERGENCY LIGHY	1.0	BASEMENT
1365735	STAIRWELL	BOTTOM ON PIPING	0.6	BASEMENT
1365728	STAIRWELL	BOTTOM ON WINDOW SILL	0.4	2ND FLOOR
1365739	STAIRWELL	LOBBY TO LEFT CORNER IN CUP	0.7	1ST FLOOR
1365764	STAIRWELL	ON EMERGENCY LIGHT	0.1	2ND FLOOR
1365757	STAIRWELL	TOP LEFT CORNER ON ELECT BOX	0.6	1ST FLOOR
1365646	STAIRWELL	TOP LEFT SIDE NEAR HAND RAIL	0.4	1ST FLOOR
1365713	STAIRWELL	TOP ON FIRE ALAMR	0.4	2RD FLOOR
1365674	STAIRWELL	TOP ON WINDOW SILL	0.4	2ND FLOOR
1365763	STAIRWELL	TOP ON WINDOW SILL	0.7	1ST FLOOR
1365439	STORAGE	RT CORNER METAL MAIL BOX	1.9	BASEMENT MAIL BOX STORAGE RM
1365750	WOMEN'S RM	ON TOP OF TOWEL DISPENSER	2.3	BASEMENT

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