

Quality Assurance Project Plan

State Radon Monitoring Program
Measuring Indoor Radon Concentrations using *Name of Detector*

Submitted to

Name of Project Officer, Project Officer
U.S Environmental Protection Agency
75 Hawthorne Street
San Francisco, California 94105

Submitted by

Name of Organization
Address

Prepared by

Environmental Officer or Contractor
Department
Organization

Date

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1.0 Introduction

General sentence about the State program (location, area, population, types of buildings). As part of the State's on-going effort to investigate site-specific and area-wide environmental and human health concerns, the name of environmental department proposes to assess homes, other buildings, and planned future buildings for the presence of radon.

This Radon Project (RP) is designed as a research and screening program to assist in the evaluation of the presence of radon in homes and other buildings in the *State of XXXX*. Results from the RP will be reviewed to develop a plan for mitigation, if necessary, as funding becomes available.

1.1 Sampling Area

Homes and other buildings are located (*describe location on map* (Figure 1)).
The choice of location depends on individual request. Occasionally _____ may target an area.

Place map here

Figure 1

1.2 Survey locations and Sampling Sites

The area includes *extent of physical boundaries*. The *name of the community* is located (*location within the state*). Radon levels in existing residences and other buildings, as well as planned buildings (after construction); will be determined at as many locations as is practical.

1.3 Responsible Agency

The RP Project Manager will be responsible for conducting and/or overseeing the sampling necessary to execute and maintain the RP. *Name of State* has committed personnel and resources to implement the RP, including, but not limited to, the certification of training of appropriate personnel to conduct sampling in accordance with the procedures provided in the plan.

1.4 Project Organization

The general organizational structure of the RP is detailed below:

Project Manager: _____

Analytical Laboratory: _____

Quality Assurance Manager: _____

The Project Manager will be the primary contact and will implement monitoring, send out test kits, receive data from the laboratories and maintain records. The *name of laboratory* will provide *name of detectors* to the State and be responsible for their analysis after exposure. The Quality Assurance Manager will provide independent oversight for project data quality.

1.5 Statement of the Specific Problem

The State manages activities that promote the protection of human health and the environment. The inhalation of radon at levels greater than 4.0 pCi/L over prolonged periods of time poses a significant risk to human health. Prolonged exposure to radon and its decay products may increase the potential of developing lung cancer. Radon is present at some level in almost every region of the U.S. The amount of radon in a particular building depends on the geology specific to the location of the building, building design and ventilation, and the amount of force that draws radon into the building from the soil. Given the fact that the geology beneath different buildings varies significantly, as do the materials used to construct individual buildings, it is recommended that all buildings be tested for the presence of radon. The data gathered in this investigation will be used to determine the need for remedial action.

2.0 Background

2.1 Site Description

Air samples may be collected from residences and other buildings, as well as new buildings (after construction). Individual homeowners may also request test kits.

2.2 Operational History

The State operates and maintains public buildings and may occasionally take samples from these locations.

2.3 Previous Investigations/Regulatory Involvement (if applicable)

A preliminary assessment of radon contamination was conducted in *number of homes, number of buildings* in year.

2.4 Geologic Information

The State is located *geographic location*. The *general type of soil* is composed primarily of (*soil composition*) rock and has (*drainage characteristics*). Provide a *general description of the landscape*. For targeted studies, more specific geologic information should be included here.

2.5 Environmental and/or Human Impact

Inhalation of radon at levels greater than 4.0 pCi/L over prolonged periods of time poses a significant concern to human health. Prolonged exposure to radon and its decay products may increase the potential of developing lung cancer.

3.0 Project Quality Objectives

3.1 Project Task and Problem Definition

The State has established a monitoring program to test residential properties, as well as other buildings and *the geographic location of buildings* that may be constructed in the future, to determine levels of radon gas present that may be impacting human health.

Monitoring will include:

- Sampling for radon.
- Analysis of samples to determine the level of exposure.
- Reporting results to the public.
- Making recommendations for remediation of high levels.
- Retesting properties with radon levels over 4.0pCi/L

3.2 Data Quality Objectives

Data for this project are intended to assist *the State* in decision making for remediation of residential and other buildings exhibiting levels of radon equal to or greater than 4.0 pCi/L. The data should be adequate to address the following concern:

What is the average level of radon present in individual buildings? Is it at a level equal to or greater than the U.S. EPA's action level of 4.0 pCi/L?

In the event that the radon concentrations meet certain action levels, *the State* will implement the following actions in accordance with *Protocols for Radon and Radon Decay Product Measurements in Homes* (ANSI/AARST MAH 2014), p.4 Extended Testing Protocol.

Action Levels Radon	Actions
Data from individual building less than 4.0pCi/L	No further monitoring required. However, levels between 2.0 and 4.0pCi/L may be considered for mitigation.
Data from individual building equal to or greater than 4.0pCi/L	Interim mitigation by balancing HVAC system and/or increasing ventilation. Follow up with second test.
Average of the data from initial test and the second test equal to or greater than 4.0pCi/L	Recommend remediation of building in accordance with EPA 402-R-93-078 <i>Radon Mitigation Standards</i> .

3.3 Data Quality Indicators (DQI)

Data quality indicators (DQI) (accuracy, precision, completeness, representativeness, comparability and method detection limits) refer to quality control criteria established for various aspects of data gathering, sampling, or analysis activity. Given the limited scope of the project, the relevant data quality indicators are:

- Detection limits of the analytical method (see EPA Section 5.1)

- Standard quality control conducted by the laboratory
- Field duplicates and field blanks collected by the monitoring technicians submitted blind to the analyst (see EPA Section 9.0)
- Complete record keeping by field and data entry technicians
- Review of data entered into database

3.4 Data Review and Validation

The Project Manager will review the laboratory report for compliance with the DQI's.

If the sample results do not comply with quality standards, the Project Manager will:

- Flag the data that are not in compliance
- Review the field notes for irregularities or inconsistencies
- Contact the analytical laboratory to discuss actions taken to correct problems

3.5 Data Management

The Project Manager will conduct or supervise staff in the compilation and evaluation of the data collected, based on recommendations outlined in EPA guidance *Indoor Radon and Radon Decay Product Measurement Device Protocols* (EPA 402-R-92-004, July 1992) Sec. 1.2.4 or ANSI; a copy of the EPA document is included as a reference in Appendix A.

- Data will be transferred to a spreadsheet or database approved by the *State environmental department*. Summary data tables will be created and statistics performed to determine if the residential and other buildings meet the long-term exposure action level of 4.0 pCi/L or greater.
- A summary report will be prepared showing the results of the monitoring including Task 1 above, the laboratory reports, field data sheets, chain of custody forms, and the assessment conducted by the *title of environmental officer*. The results will be reviewed with respect to the data quality objectives (see Section 3.2), and changes will be recommended to the QAPP if appropriate.
- After the data have been entered into electronic spreadsheets and/or databases, copies of all hard and/or electronic documentation will be stored off-site in a locked, fire-proof file cabinet. *Describe specific to the State data management process.*

3.6 Assessment Oversight

The *environmental officer* will review the project to determine whether:

- Field quality control measures have been conducted (e.g. duplicate and blank sample collection)
- Laboratory quality control measures have been conducted in accordance with the Standard Operating Procedures
- Data transferred from laboratory reports have been entered correctly into tables, charts, or graphs for evaluation
- Data quality objectives have been met and data quality indicators have been achieved
- Procedural changes made in the field or laboratory are incorporated in the QAPP
- And any other QC information that the State wants to include (e.g., unexpected concentration spikes)

The *environmental officer* will document the RP evaluation in a memorandum. This shall be submitted to the Project Manager *within _____ number of days*. A hard copy will be placed in the project file.

4.0 Sampling Protocol

4.1 Sampling Locations

The environmental department will test residential buildings and all public buildings that are currently in use. This includes: titles of buildings in addition to residential buildings. (if this is a targeted assessment, describe sampling locations here.)

4.2 Element of Concern

Radon is the element of concern for which sampling is to be conducted in buildings. The inhalation of radon at levels equal to or greater than 4 pCi/L, over prolonged periods of time, poses a significant concern to human health. Levels above 10pCi/L are more hazardous and are cause for immediate mitigation. Since it has not been absolutely determined what constitutes a safe level of exposure, homeowners with radon levels from 2 to 4pCi/L may want to take mitigation measures. A long term goal of the federal government is to reduce indoor levels of radon to the average outdoor level of 0.4pCi/L.

4.3 Frequency

One-time sampling is proposed which will serve as a screening for the presence of radon in individual buildings. EPA guidance *A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon, 402-K-07-009* recommends that action be taken to reduce

indoor radon levels in public and residential buildings if there is a radon test with results of 4pCi/L or higher. *The State will recommend longer term sampling (initially 60 to 90 days) in order to determine whether or not another test is needed. Additional sampling events may be advisable to evaluate any future construction.*

5.0 Analytical Methods

5.1 Analysis Narrative

Radon Test Kits will be placed in homes and public buildings during the winter months or in closed building conditions according to EPA Guidelines as detailed in “*Protocols for Radon and Radon Decay Product Measurements in Homes*” (EPA 402-R-92-003). Radon samples will be collected at as many building locations as possible using the *name of detector*. Duplicates will be collected at 10% of the locations. Field blanks will be collected at 5% of the locations tested. Test kits will be sent in for analysis to *name of laboratory* following chain of custody procedures with supporting documentation and laboratory protocols.

Continuous monitors will be calibrated and have background checks at facilities as recommended by certification requirements, licensure requirements or the manufacturers recommendation. Monitors are calibrated once a year at minimum. Duplicates are deployed in 10% of each monitors measurement locations. A collocated device may also be used to help ensure check quality.

5.2 Analytical Laboratory

The analytical laboratory selected for the project is *name of laboratory*. The laboratory is licensed by the *licensing agency*, License # _____.

6.0 Field Methods and Procedures

6.1 Field Methods for use of *name of test kits*.

6.1.1 Method (EPA 402-R-92-004, 1992, Sec. 2.2)

Name of detectors are passive sampling devices that need only be open to the atmosphere to collect data. The *name of kit* contains an alpha sensitive foil inside a filtered diffusion chamber. As the radon decays inside the chamber, alpha particles are released that imprint the foil, leaving a "track." When the detector is analyzed, the radon concentration is calculated from the number of tracks and number of days the kit was deployed. Concentration is reported in picocuries per liter (pCi/L)

Long-term test kit: Name of detector is designed for longer term use, from three (3) months to one (1) year and does not require closed house conditions. Include information about this process or refer to an SOP, which is included in the Appendix.

6.1.2 Measurement Conditions (EPA 402-R-92-004, 1992, Sec. 1.2.2)

To the extent possible, the *environmental department* will ensure that the following general conditions exist prior to and during a measurement period to standardize the measurement conditions:

- Winter is the preferred season for sampling as windows and doors are more often closed to cold weather. If measurements must be made during a warmer season, meeting the criteria listed below will satisfy the closed-building conditions.
- Internal-external air exchange systems (other than a furnace) such as high-volume attic and window fans will not be operating during measurements of and for at least 12 hours before measurements are initiated.
- Air conditioning systems that recycle interior air may be left on.
- Normal operation of permanently installed air-to-air heat exchangers may also continue during closed-building conditions.
- Where permanent radon mitigation systems have been installed, the operational schedules of these systems should continue to be followed during the measurement period.
- Closed-building conditions will be verified and must be maintained when they are not the normal living conditions.

6.1.3 Measurement Device Location (EPA 402-R-93-003, 1993, Sec. 2.2) and (EPA 402-R-92-004, 1992, Sec 1.2.3).

- Measurements will be made in the lowest lived-in level of the house. The following criteria will be applied to select the location of the detector within a room on this level. A position will be selected where the detector will not be disturbed during the measurement period and where there is adequate room for the device.
- The detector will be located away from drafts caused by heating, ventilation, and air conditioning vents, doors, fans, and windows. Placing detectors near excessive heat, such as a fireplace or in direct sunlight, and areas of high humidity, will be avoided.
- The detector location will be further than 90 centimeters (3 feet) of windows or other openings in the exterior wall. If there are no potential openings (e.g. windows) in the exterior wall, the measurement location will not be within 30 centimeters (1 foot) of the exterior walls of the building.
- The detector will be at least 50 centimeters (20 inches) from the floor, and at least 10 centimeters (4 inches) from other objects. For those detectors that may be suspended, an optimal height for placement is in the general breathing zone, such as 2 to 2.5 meters (about 6 to 8 feet) from the floor.
- In general, measurements will not be made in kitchens, laundry rooms, closets, or bathrooms.

6.1.4 Retrieval of Detectors (EPA 402-R-92-004, 1992 Sec. 2.4.8)

At the end of the monitoring period, the detector will be inspected for any deviation from the conditions described in the measuring device instructions or logbook at the time of deployment. Any changes will be noted. The detector will be resealed using the original protective cover, then returned to the laboratory as soon as possible for analysis.

6.1.5 Field Equipment

The following equipment will be used to measure radon:

- A test kit (provided by the laboratory) that includes name of detector sealed with a

- protective cover
- An instruction sheet and sampling data sheet for the test location
- A shipping container, along with appropriate mailing label
- A data collection sheet or logbook

7.0 Disposal of Residual Materials

In the process of collecting environmental samples at the testing sites during the investigation, if the monitoring device is found to be defective or has been disturbed during the test, the following disposal procedure is recommended: For the low levels of contamination and routine sampling that will likely be found, disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and may be sent to a municipal landfill.

8.0 Sample Documentation and Shipment

8.1 Field Notes and Logbooks (if *the State* puts the kits in place)

At a minimum, the following information will be recorded during the collection of each sample. (EPA 402-R-92-004, 1992, Sec. 1.2.4)

- Sample location and description
- Name of technician
- Date and time of sample collection
- Field observations and details related to analysis and/or integrity of samples (e.g. weather conditions, noticeable drafts in testing room, unusual temperatures, noticeable humidity, and/or any other unusual condition present during the time of testing.)

A copy of the field data/instruction sheet is included in Appendix C.

8.2 Labeling

All samples collected will be clearly labeled for proper identification in the field and for tracking in the laboratory. All labels are pre-applied to the individual test kits. Each *name of detector* and information card has a unique 6-digit identifier that corresponds to the foil in the detector. These numbers are used to reduce the potential for sample misidentification. The following information will be included on the label:

- Resident identification number (or applicable duplicate or blank identification number)

- Detector number
- Test location
- Start date and end date of sample

8.3 Chain of Custody Forms and Custody Seals

A chain of custody record will accompany all sample shipments for analysis. The chain of custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in that person's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel only. When samples are shipped, the custody of the samples will be the responsibility of the *State*. The designee will sign the chain of custody form in the "relinquished by" box and note date, time, and unique monitor number.

Sample numbers for all samples, field duplicates, and blanks will be documented on this form. A request for the laboratory to use one of the samples for laboratory QC sample will also be noted on this form. A copy shall be made for the *environmental department* project files. A copy of the chain of custody form is included in Appendix C.

8.4 Packaging and Shipment

The following packaging procedures will be followed for all samples.

All sample containers will be placed in a strong outside shipping container as needed.

- Seals will be checked on the individual test kits for tightness.
- Empty space in the shipping container will be filled with bubble wrap or packaging peanuts to prevent movement and possible loosening of seals on test kits during transport or shipment.
- Each shipping container will be securely taped shut with fiberglass strapping tape, and custody seals will be affixed to the front, right and back of each shipping container.

Records will be maintained by the *State* of the following information:

- Copy of the chain of custody form
- Total number of test kits shipped to the laboratory
- Carrier, air bill number(s), method of shipment (i.e. priority, next day)
- Shipment date and date the laboratory should receive the test kits.

9.0 Quality Control

9.1 Field Quality Control Samples (*if applicable*)

9.1.1 Duplicates (Collocated) Detectors (EPA 402-R-92-004, 1992, Sec. 2.4.11.3)

Duplicate detectors (field duplicate) samples will be collected to monitor the precision of the measurements. A duplicate will be collected for 10% of the devices that are deployed. Duplicates will be labeled with a unique location identification number known only to the staff of the *environmental department* and will be submitted blind to the analytical laboratory.

Precision will be monitored using the results of the duplicate detector analyses. Duplicate measurements should achieve a relative percent difference of 10% or less at 4pCi/L or greater (EPA 402-R-92-004, 1992, Sec. 2.4.10.2).

9.1.2 Field Control Detectors

Field Control Detectors (field blank) samples will be used to monitor the *name of detector* response to handling, storage, and shipment. Field blanks are unexposed detectors that are moved through the sampling protocol and handled in the same manner as exposed detectors, then analyzed. Blanks will be collected for 5% of the devices that are deployed. Blank samples will be labeled with a unique identification number known only to the staff of the *State* and will be submitted blind to the analytical laboratory. Any value above the lower limit of detection (LLD) will prompt an investigation at the laboratory to determine the cause of the elevated reading.

9.2 Laboratory Quality Control Samples

The laboratory will conduct QC checks in accordance with its Standard Operating Procedures and Quality Assurance Plan. (See Appendix B)

9.2.1 Spiked Samples

Spiked samples are detectors that have been exposed to known concentrations in a radon calibration chamber traceable to NIST or equivalent Standards Laboratory. Spiked samples should be at least 3% of all measurements performed. The average value of the spiked detectors must be within +/- 25% of reference value.

10.0 Field Variances

As conditions in the field vary, it may become necessary to implement minor modifications to sampling as presented in this plan. When appropriate, the QA Manager will be notified and a verbal approval will be obtained before implementing the changes. Modifications to the approved plan will be documented in the final report (Section 3.6). Significant revisions should also be incorporated into the written plan.

11.0 Field Health and Safety Procedures

Monitoring technicians must follow the safety guidelines required by *environmental department* in accordance with the Occupational Safety and Health Administration (OSHA) Standards and Guidelines and provisions of the Occupational Safety and Health Act of 1970.

Appendices:

Appendix A: References

1) Indoor Radon and Radon Decay Product Measurement Device Protocols

EPA 402-R-92-004, July 1992

2) Protocols for Radon and Radon Decay Measurements in Homes

EPA 402-R-93-003, June 1993

3) A Citizen's Guide to Radon: The guide to protecting yourself and your family from Radon

EPA 402-K-07-009, Revised May 2007

Appendix B: Laboratory Standard Operating Procedures, Technical References, and Forms (Quality Assurance Manual)

Pg. ____ QA Program for Radon Testers Using *name of detectors*

Pg. ____ Technical Information for *name of detectors*

Pg. ____ Radon System Calibration:

Pg. ____ Background Calculation:

Pg. ____ Sample Chain of custody form

Appendix C: Forms

Field Data Form