

**American Association of Radon Scientists and Technologists, Inc.
Announcement**

*Abstracts Accepted For Presentations and/or Poster Sessions
2012 International Radon Symposium*

July 24, 2012 Update: The following abstracts have been accepted for presentation and poster session presentation by the peer review committee of the 2012 International Radon Symposium, to held in Las Vegas, Nevada from October 14-17, 2012. An initial program will be published in early July, 2012 and this draft program will delineate times and whether the presentation is to be a poster session or an oral presentation.

Some of these abstract presentations may occur during the joint meeting day and all presentations and publication of subsequent papers are contingent upon the researcher's acceptance and completion of the full requirements of the Symposium Proceedings Editorial committee. Please check the International Radon Symposium web site for ongoing program updates.

www.internationalradonsymposium.org



**RADON CONTROL IN NEW HOMES:
A META-ANALYSIS OF 25 YEARS OF RESEARCH**

Angell, William¹

¹Midwest Universities Radon Consortium (MURC), College of Design, University of
Minnesota

Abstract

Without effective radon control in new homes, national radon reduction programs will fail to achieve radon risk reduction goals. While there have been research over the past 25 years focusing on radon control in new low-rise residential houses, the individual investigations have been limited in scope. This paper presents a meta-analysis of research on residential radon control strategies, common problems with these strategies, and the relative efficacy on radon control strategies in new homes. The conclusions of this analysis include passive soil depressurization (PSD), installed according to recognize standards and guidance, appear to produce about a 50% indoor radon reduction. A significant share of PSD systems are not installed according to generally accepted standards or guidance. Active soil depressurization produces greater indoor radon reduction than PSD. Further research is needed to clarify the efficacy of passive barriers in new construction.

Keywords: radon, radon control, radon prevention, new homes, building codes, standards

**THE ASSESSMENT OF THE RADON PROBLEM IN SWITZERLAND
AND THE NEW NATIONAL RADON ACTION PLAN 2012-2020.**

Fabio Barazza
Scientific Assistant
Federal Office of Public Health
Switzerland
fabio.barazza@bag.admin.ch

Abstract

The potential risk of indoor radon for the public in Switzerland has been comprehensively investigated by the Federal Office of Public Health since 1994. Numerous radon measurements have been carried out to date and they show that several regions in Switzerland are affected by high levels of radon exposure. In a pilot study different methods of indoor radon prevention and remediation have been applied and tested. The results of these investigations and their implications are presented and it is shown how the findings are used to inform and advise the public concerning protection against radon and how the radon expertise and the continuing education of construction experts is sustained. Furthermore, we present the new national radon action plan (2012-2020) approved by the Swiss Federal council, which incorporates the conclusions drawn from our investigations and describes how we plan to implement our current level of knowledge into practice.

UPDATE ON CANADA'S NATIONAL RADON PROGRAM

Bijlani, Deepti S. And Whyte, Jeffrey
Radiation Protection Bureau, Health Canada
Canada

Abstract

Health Canada continues to deliver the National Radon Program. This presentation will highlight recent developments and will focus on specifics related to the recently completed Cross-Canada Survey of Radon Concentrations in Homes and Health Canada's support of the newly launched Canadian National Radon Proficiency Program (C-NRPP).

The Cross-Canada Survey of Radon Concentrations in Homes was a 2 year study conducted from fall 2009 through 2011. Roughly 18000 participants were randomly recruited from across Canada to complete a long-term radon test during the fall/winter heating seasons. Approximately 14000 radon test results were obtained. This presentation will focus on some of the specifics of the survey. In April 2012, Health Canada's collaborative effort with NEHA-NRPP and AARST culminated in the development of the C-NRPP. The presentation will highlight key features of the program, differences in the Canadian guidelines/protocols and Health Canada's supportive role related to this new certification program.

KITIGAN ZIBI ANISHINABEG RADON TESTING AND MITIGATION PROJECT

Marcel Brascoupe
MB Radon Solutions
Kitigan Zibi Anishinabeg
mbrascoupe@gmail.com

Abstract

In the mid 1990s, a sample of homes were tested for radon levels by Health Canada in the First Nation community of Kitigan Zibi Anishinabeg. None of the homes tested at that time exceeded the set action level which at the time was 800 Bq/m³. This action level was consequently reduced to 200 Bq/m³ by Health Canada in June of 2007. The Kitigan Zibi Anishinabeg First Nation Band Council decided in 2008 to test *all* the homes in the community to get an insight into how many homes now exceeded the new action level of 200 Bq/m³. The Kitigan Zibi Anishinabeg First Nation Band Council decided to fund this initiative themselves and mandated the Radiation Safety Institute of Canada to do long-term testing in all the homes in Kitigan Zibi Anishinabeg during the winter months from December 2008 to March of 2009.

Of the 424 homes tested, 180 of the homes showed levels above 200 Bq/m³. Of these 180 homes, 32 of them had levels above 600 Bq/m³. Upon receiving the results of this testing, the Kitigan Zibi Anishinabeg First Nation Band Council immediately set in place a communications plan to inform the community members of the results of the radon testing and started developing an action plan to correct the problem in the 180 homes that were affected with high radon levels.

Abstracts Accepted For Presentations and/or Poster Sessions
2012 International Radon Symposium – Las Vegas, Nevada U.S.A.

At this time, the Kitigan Zibi Anishinabeg First Nation is the only community in all of Canada that has conducted long-term testing in all the homes in the community and that has remediated all those homes that were affected with high levels of radon gas. Many lessons were learned in the process.

**RADON MITIGATION IN COLD CLIMATES AT KITIGAN ZIBI
ANISHINABEG**

Mathieu Brossard,* Celine Brazeau Ottawa†, Renato Falcomer, ‡ and Jeff Whyte‡

* Environmental Health Program, Health Canada– Quebec region

† Kitigan Zibi Anishinabeg Health & Social Services

‡ Radiation Protection Bureau, Health Canada.

Abstract

Radon mitigations were done in approximately seventy houses mainly by installing sub-slab depressurization systems (SSDS) with two types of discharge and fan locations: Ground level discharge with the fan located in the basement (AGL) or roof-discharge with the fan located in the attic. A comparative analysis of the mitigation efficiency and of the exhaust icing was made. Results show that both SSDS scenarios reduce radon similarly. The results of SSDS with AGL show that a sealed radon fan with proper fittings and sealed piping were able to reduce the radon to acceptable levels and were less subjects to obstruction of the exhaust from icing in cold climates.

**A GEOLOGIC MAPPING APPROACH TO IDENTIFY RADON HOT-
SPOTS IN CALIFORNIA AND RAMIFICATIONS FOR THE STATE'S
RADON RISK PICTURE**

Ronald Churchill
Senior Engineering Geologist
California Geological Survey, Sacramento, California

Abstract

The California Geological Survey (CGS), in cooperation with the California Department of Public Health--Radon Program, has completed seven detailed radon potential maps at 1:100,000 or 1:48,000 scales since 2005. The CGS mapping process uses: 1) geologic maps; 2) short-term indoor-radon data; 3) sediment, soil and rock uranium data; and 4) soil data. CGS maps depict up to 5 radon potential categories, defined by percentages of homes exceeding 4 pCi/L: very high, high, moderate, low or unknown. CGS mapped high radon potential areas in western Los Angeles County correlate well with high radon potential Zip Code areas identified by a 1991 study using year-long house radon measurements. The CGS maps show California has significant high radon areas but many are too small for detection by the 1990 statewide radon survey and, consequently, are not represented by the US EPA Radon Zones or the LBL High Radon Project maps.

THE UK MINISTRY OF DEFENCE
RADON SAFETY PROGRAMME

Dee Emerson
Radiation Protection Group
Defence Science and Technology Laboratory (DSTL)
United Kingdom

Abstract

The Radon Safety Programme (RSP) on the UK Ministry of Defence (MoD) estate has been in place since 2005. The UK has statutory legislation in place to protect employees from radon exposure and the MoD has established a robust policy to ensure the health and safety of its personnel.

The RSP covers thousands of workplace areas including caves, underground bunkers, aircraft hangers and office buildings, with the aim of protecting the health of military and non-military personnel now and in the future. MoD also implements a duty of care policy that extends beyond the workplace to include barrack accommodation and military family accommodation. Communication of the radon risk in a non-technical way is essential to these populations.

The paper will overview the radon monitoring strategy, the monitoring results and the remediation techniques employed. In addition, the methods of communication of radon issues to stakeholders will be described.

INDOOR RADON SURVEY IN WORKPLACES USING NUCLEAR TRACKS METHODOLOGY

Arturo Angeles¹ y Guillermo Espinosa²
espinosa@ifunam.unam.mx

¹Instituto Nacional de Investigaciones Nucleares.

²Instituto de Física, Universidad Nacional Autónoma de México
Circuito de la Investigación Científica, Ciudad Universitaria. 04520, México, D.F.

In this paper, the preliminary results of indoor radon concentration measurements in some Mexico City Schools are shown. As it is known, the indoor radon concentrations can represent a health problem. In several countries, there exist regulations which restrict or suggest “acceptable” radon air concentrations in workplaces. Because of the fact that in Mexico there are no regulations in this issue to reach this objective, we’ve been evaluating radon air concentrations in some Mexican workplaces such as kindergartens, primary and high schools, research labs and financial offices, by the nuclear track method. With the resultant radon concentrations values the equivalent dose is calculated for these places using the occupational time when appropriate. Also, historic radon concentration values in other Mexican places published in some papers has been integrated to enhance the efficacy of our values. These equivalent dose value calculations suggest some likelihood for adverse health effects and suggest that a restriction be placed on those work conditions. It is important to point out the fact that this is the first time these kinds of base measurements have been made in Mexico. The author wishes to thank J.I. Golzarri for his technical help. This work was partially supported by PAPIIT-DGAPA-UNAM Project 1N101910.

**A REGIONAL SCALE RADON MONITORING NETWORK IN THE
VOLCANIC ISLAND OF TENERIFE, CANARY ISLANDS (SPAIN)**

Ronaldo Viñas^{1,2}, Antonio Eff-Darwich^{1,3}, José A. Rodríguez-Losada^{1,3}, Luis E. Hernández^{1,2,3}

(1) Departamento de Edafología y Geología, Universidad de La Laguna, Spain

(2) Gobierno de Canarias, Spain

(3) Instituto Volcanológico de Canarias INVOLCAN, Spain
litoteca@yahoo.es

Abstract

The emanation and transport of radon is being extensively studied in the volcanic island of Tenerife, Canary Islands (Spain). A radon monitoring network has been deployed in a series of boreholes that were drilled in areas of different geological and lithological settings. In this sense, the transport of radon might be studied from the topographic surface down to 30 meters depth. A large lithological database (more than 200 samples from volcanic rocks of the Canaries) has been built to study the likely relationship between radon concentration and geochemical and physical properties of the rock matrix. We also present examples of radon measurements at homes, where large concentrations exceeding the international safety limits were found.

RADON RISK AT YOUR FINGER TIPS-A CONVENIENT APP

Willard E Hobbs & Christopher K Hobbs
Radon Reduction & Research
Santa Barbara, CA 93105

Abstract

We have constructed an app for Apple devices that shows geographical areas of high indoor radon concentrations. This app uses Santa Barbara County maps compiled by the California Geologic Survey which, in turn, made use of various geologic maps and studies of the occurrence of various forms of radioactivity¹. The analysis shows regions of high potential for indoor radon levels above 4 pCi/L in red, moderate potential for elevated indoor radon in yellow and low potential for indoor radon uncolored. The coordinates from the State map are equated with those of Google Maps API to construct the app. This is extremely convenient because of the various features thereby employed. A specific addresses can be designated which then will be indicated on the map. It is possible to enlarge the region desired to show street names and actual parcel boundaries; the radon risk regions will simultaneously be enlarged. The result is an extremely convenient tool to assess and communicate radon risk. The app is available free at the iTunes store as “Radon Map for Home Safety and Testing.”

¹Churchill, Ron K; California Geology V 50, Nov/Dec 1997, pp 167-177, also
[http://www.consrv.ca.gov/cgs/minerals/hazardous_minerals/radon/Radon Mapping.pdf](http://www.consrv.ca.gov/cgs/minerals/hazardous_minerals/radon/Radon_Mapping.pdf)

**SHORT-TERM VS. LONG-TERM INDOOR RADON
MEASUREMENTS**

Willard E Hobbs
Radon Reduction & Research
Santa Barbara, CA 93105

Abstract

The results of radon measurements in 57 houses in Santa Barbara, California, are studied. The houses were chosen from various cohorts including the Rincon Shale Geologic Formation. 66 houses had short-term measurements on the Rincon and a control group of 70 houses had measurements off the Rincon. Subsequently, all study houses were given the option of a long-term measurement and the 57 houses were successful in completing both measurements. Both short-term (2-4 day) and long-term (1-year) measurements were made in similar locations in each of the houses and all followed the EPA protocols required for the two types of measurements. The long-term measurements are taken as the “exact” representation of the average levels of radon for the buildings. This collection of data provides an indication of the value of using a short-term measurement in evaluating radon risk. When the logarithms of the long-term data are plotted against the logarithms of the short-term data, a linear relation is approximated with a correlation coefficient of 71%. Thus, a power-law relation is suggested. An important result of the analysis is that the short-term tests did not give a low reading (<4) for any house for which the long-term test gave a high reading (>4). In this quality, the short-term measurement is conservative and its value as a screening tool is verified.

**ASSESSMENT OF OCCUPATIONAL EXPOSURE TO AIRBORNE
RADON IN MINNESOTA WATER TREATMENT PLANTS-A
FOLLOW-UP STUDY**

Joshua J. Kerber
Minnesota Department of Health
St. Paul, MN 55164-4618
joshua.kerber@state.mn.us

Occupational exposure to airborne radon can be a significant source of ionizing radiation. Water treatment plant (WTP) operators may be at increased risk of radon exposure resulting from water treatment processes. In 1999, MDH placed alpha track radon detectors in a small number of WTPs in Minnesota to evaluate this risk. As a follow-up, MDH completed a more extensive assessment of airborne radon in these WTPs in winter 2003. Results from the survey indicate highly elevated hourly airborne radon concentrations related to operations within the WTPs. In 2012, MDH expanded this study into 13 WTPs to determine worker’s radon exposure in different types of WTPs throughout MN. Working level months were calculated for times operators were present in the WTPs. Since occupational exposure to radon can exceed federal standards, it is practical to monitor WTP operators’ radon exposure and provide recommendations to lower their risks.

ASSESSMENT OF RADON EXPOSURE RISK IN HOUSEHOLD ENVIRONMENTS

Yoon Shin Kim, Cheol Min Lee, Sun Ju Nam Gung, Lisa Ro
Institute of Environmental & Occupational Medicine, Hanyang University
yoonsin@hanyang.ac.kr

Abstract

This study evaluated the exposure dose rate of radon for residents in various types of dwellings in high radon concentration (~10%) areas and the relative excess lung cancer risk for 6 months, using α track detector. The average radon concentration was 79.3 ± 74.2 Bq/m³. Among various building materials, only wooden structures exceeded radon concentrations of 100 Bq/m³. Furthermore, the 1st floor appeared to have the highest radon concentrations. Females and elementary school students showed exposure dose rates of 1.2 mSv/y and 1.3 mSv/y respectively. Males measured 0.9 mSv. Additionally, mortality risks from related lung cancer were 5.83% in males and 2.57% in females, calculating basal lung cancer mortality on demographic data from radon exposure. Finally, the relative excess lung cancer risk of females and males by radon exposure were 67 persons/10⁶·y and 7/10⁶·y. This study led to a meaningful result for creating a fundamental methodology for measuring radon risk in typical Korean dwellings.

Keywords

Exposure dose rate, radon, relative excess lung cancer risk, construction materials, dwellings, indoor

AN ECOLOGICAL STUDY OF RADON AND 13 TYPES OF CANCER

Michael E. Kitto^{1,2} and Nataliia Kovalchuk²

¹Wadsworth Center, New York State Department of Health, P.O. Box 509, Albany, NY 12201 ²School of Public Health, State University of New York, Rensselaer, NY 12144

Abstract

Cancer is one of the most common chronic diseases in the US, and is second only to heart disease as the leading cause of death. Each year about 100,000 New Yorkers are diagnosed with cancer. The New York State Cancer Registry (CR) provides separate statistics regarding incidence and mortality of over a dozen types of cancer in males and females, based on data collected since 1976. In the past few years several studies worldwide have suggested that environmental radon exposure may be a risk factor for various cancers. In this study, gender-specific CR maps and radon potential maps are visually compared, and the data are plotted to develop correlation coefficients. Results show a poor correlation exists for radon exposure and many types of cancer. Further studies are necessary to overcome ecologic design limitations and to determine whether any relationship is generalizable to state, national, and international settings.

**ESTIMATING RADON-RELATED DEATHS AT THE TOWNSHIP
LEVEL**

Michael E. Kitto

Wadsworth Center, New York State Department of Health, P.O. Box 509, Albany, NY 12201
and School of Public Health, State University of New York, Rensselaer, NY 12144

Abstract

While radon exposure is responsible for approximately 21,000 lung cancer deaths every year in the United States (US), the number of radon-related deaths in a particular state remains generally unknown. In an effort to quantify such a value for New York State (NYS), in 2007 we developed maps and tables of the radon potential for each of the ~1000 towns and cities in NYS using a combination of measurements and correlations to surficial geology. These data allowed for the development of a model to numerically estimate the risk per unit exposure (lung cancer deaths per working level month). In addition, by applying town-level radon potential, US census data, and models from NCRP, ICRP, and BEIR, an estimate of the radon-related deaths in each town and county in NYS can be made. Results show that while 28% of lung-cancer deaths occur in the county with the greatest radon potential, the greatest number of radon-related deaths occurs in counties with low radon potential and high populations.

**CHARACTERIZATION AND USE OF AN ACCUMULATING TYPE OF
RADON TEST CHAMBER**

Paul Kotrappa and Frederick Stieff
Rad Elec Inc.
Frederick MD 21704
PKotrappa@aol.com

Abstract

There are two general types of radon test chambers. One type of radon test chamber can be described as a “flow-through” radon chamber while the second type can be described as an “accumulation” radon test chamber. The Bowser-Morner radon test chamber is an example of a “flow-through” type. These are generally used for “performance testing” of certified radon detectors. By comparison, an “accumulation” chamber is typically much smaller (ranging in size up to approximately 40 liters), and are relatively inexpensive to fabricate and operate. The radium source and radon detectors are introduced into an “accumulation” chamber through a sealable port, after which the port is sealed. When a NIST Radon Emanation Standard is used as a radium source, it is possible to calculate the expected radon concentration after a specified accumulation period. This paper describes a typical “accumulation” chamber, and provides the equations needed to calculate the radon concentration at any specified accumulation time, as well as highlighting some practical and unique applications of such test chambers.

THE USE OF BARRIER BAGS WITH RADON DETECTORS

Alexandra Stieff, Paul Kotrappa and Frederick Stieff
Rad Elec Inc.
Fredrick, MD 21704
PKotrappa@aol.com
Abstract

Radon detectors are widely used both for research and for monitoring indoor and outdoor radon. During some applications, detectors need to be enclosed in barrier bags which are totally transparent to radon. In other applications, radon detectors need to be enclosed in barrier bags that are totally opaque to radon. In certain applications barrier bags may provide resistance to human manipulation. Tyvek bags appear to meet most requirements for being totally transparent to radon while providing some protection from water in harsh environments and from human manipulations. Al Mylar bags and Mylar bag with or without activated charcoal pellets appear to meet the requirement of being totally opaque to radon. The current work includes examining the performances of these barrier bags at both low and high radon concentrations and over extended periods of time.

SMALL VOLUME (53mL) EIC WITH ON/OFF MECHANISM

Frederick Stieff and Paul Kotrappa
Rad Elec Inc.
Frederick, MD 21704
PKotrappa@aol.com

Abstract

The small volume “L” Chamber (58 ml) Electret Ion Chamber (EIC) that was previously manufactured by Rad Elec Inc. did not incorporate a mechanism that allowed the chamber to be turned on and off. To rectify this problem, a re-designed small volume chamber, designated an “L-OO” Chamber, is currently being produced by Rad Elec. This newly designed L-OO Chamber (53 ml) incorporates a slide mechanism with an aperture that can be positioned over the electret in the “open” position while a solid section of the slide mechanism covers the electret in the “closed” position. The new L-OO Chamber does not respond to ionizing radiation that may occur during transit or storage. These new devices, designated as a LST-OO when loaded with a ST Electret or a LLT-OO when loaded with a LT Electret, have been approved by the NEHA-NRPP and have been assigned the following device codes: LST-OO is 8230-25 and LLT-OO is 8234-25. The L-OO Chambers, which are significantly less expensive than “S” Chambers, have been designed for radon measurements lasting from approximately 30 days to 365 days, depending upon the type of electret being used.

RADIOLOGICAL SITE ASSESSMENTS FOR THE RADON PROFESSIONAL

Michael LaFontaine, P. Phys.
Physics Solutions Inc.

Abstract

The ongoing US EPA Radon Program funding cuts (over 80% projected in the 2013 Fiscal Budget) has had major impacts on radon measurement professionals. This paper will present a number of options available to the same professionals to maintain public awareness of the presence and dangers of radon, and to continue a viable radon measurement business. Many municipal, state/provincial, and federal agencies are actively pursuing brownfield land redevelopment as a means of fiscal cost recovery. Prior to sale to a developer, these lands are subject to an Environmental Site Assessment, Phase II of which, can include a Radiological Site Assessment which most certified radon test/measurement professionals and firms are knowledgeable and equipped to perform. Measurements typically include: environmental gamma radiation at 1 metre above soil surface; ^{222}Rn concentration in soil gas; ^{226}Ra concentration in soil, and ^{222}Rn in water. Reference standards/guidelines, test protocols, and equipment will be discussed as will data analysis (including RMS errors) and equipment calibration.

U.S. STATE RADON PROGRAMS **DATA COLLECTION & PROGRAM ACTIVITIES**

Lamont, Genelle RS¹ and Angell, William²

¹Division of Environmental Health Sciences and ²Midwest Universities Radon Consortium (MURC), University of Minnesota

Abstract

Despite great strides over the past 24 years, household radon testing and mitigation remain low in the U.S. Criticisms of the U.S. Radon Program include lack of quality control and oversight for radon measurement devices and radon proficiency programs for industry; ineffective risk communication; until recently, uncoordinated federal agency efforts; and issues with radon data collection, management, and program evaluation. These problems stem from the congressional decision to create a voluntary radon program and EPA's failure to assert their full regulatory power under the 1988 Indoor Radon Abatement Act. In order to move forward a public health assessment that summarizes and analyzes both activities and limits of state indoor radon programs would be invaluable. However, to date no such appraisal has been published. This study reports the results of a cross-sectional survey delivered to state radon program representatives that assesses residential radon data collection, management, and dissemination efforts. Recommendations for future direction of state radon programs are discussed.

Keywords: state radon programs, residential radon testing, radon mitigation, data collection, data management, risk communication and radon policy

INVISIBLE INVADERS

Lizzie McGinnis and Desiree Hayes
Big Piney Middle School, Sublette County School District #9, Big Piney, Wyoming.

Abstract

The purpose of this science fair project was to determine the radon levels in houses in Sublette County and to see if the type of geology in the area affects the amount of radon in those houses. Our materials included radon test kits, volunteers, a data collection sheet, GIS website, and a geology map of Sublette County. Our procedures involved me us delivering radon test kits to volunteers with houses in and around Sublette County. We explained the test protocol to them then asked them to test their house for 3-7 days and mail the test kits in for analysis. The results were emailed to us and we recorded the data in an Excel spreadsheet. We then analyzed the data to see which areas of the county have the highest radon levels. Our experiment proved that every house we tested had radon. The EPA action level is 4 pCi/L and the houses we tested showed readings from <.3 to 16.5 pCi/L. Daniel had the highest radon average while Pinedale and Big Piney had the highest individual readings. The lowest individual readings were in Big Piney and LaBarge. We are sharing our results with the Wyoming Department of Health for their records.

A COMPARISON OF SHORT-TERM AND LONG-TERM TEST RESULTS ACROSS THE TOBIQUE FIRST NATION

Victor Nowicki

Abstract

In March 2011, approximately 300 homes were tested on the Tobique Reserve for radon presence. The method chosen was a short-term electric ion chamber (IEC) test of 2 days. This was conducted to screen the homes and obtain a picture of a concentration of radon in the homes, and the potential distribution of radon across the Reserve.

In the summer of 2011, 90 of the homes with radon concentrations from 150 Bq/m³ to 350 Bq/m³ were retested using alpha track 90 day tests. A further 200 homes were retested in March 2012, also using alpha track 90 day tests.

The paper compares the results of the two sets of tests and attempts to explain differences between the two surveys, and relates these to the numbers found and factors affecting them on the Reserve.

**AN INTEGRATED APPROACH FOR THE IDENTIFICATION OF
RADON SOURCES AND IMPLICATIONS TO REMEDIATION
STRATEGIES: A HOUSE FROM THE WORLD HERITAGE HISTORIC
CENTRE (OPORTO, PORTUGAL) AS A CASE STUDY**

Pinto, P.G.A.N.^{1,2}; Pereira, A.J.S.C.^{1,3} & Neves, L.J.P.F.^{1,4}

¹IMAR-CMA, Department of Earth Sciences, University of Coimbra, Portugal

²ppinto@dct.uc.pt; ³apereira@dct.uc.pt; ⁴luisneves@dct.uc.pt

Abstract

The remediation of existing buildings classified as World Heritage buildings, with high indoor radon concentrations and in steep terrains, is not a simple task to achieve. This is the case with the buildings of the UNESCO World Heritage Historic Centre of Oporto (Portugal). The geological bedrock is composed of a pre-Hercynian granitic rock, and the steep landform forced the emplacement of the houses in benches, built with geological materials removed from the slope excavation. The uranium content of the granite is low, so indoor radon concentrations found in some houses can only be explained by the nature of the landform, as well as the construction techniques.

Located in the historic centre, *Casa Vitória* is a recently rehabilitated three-story house in which previous studies detected high radon indoor concentrations. An innovative methodology was applied to identify the radon source based on soil-gas radon concentration, surface radon fluxes, continuous measurement of radon concentrations in the crawl-space and the indoor air, coupled with controlled ventilation tests.

Based on the results obtained, a ventilation system was installed, fully respecting the historic importance of the building. Indoor radon concentrations dropped from above 4000 Bq.m⁻³ to less than 100 Bq.m⁻³, after mitigation. This high efficiency was only possible due to the identification of the radon source.

RADON MEASUREMENT PROTOCOLS IN COMMERCIAL BUILDINGS UNDER THE PORTUGUESE LEGISLATION

Pinto, P.G.A.N.^{1,2}; Pereira, A.J.S.C.^{1,3} & Neves, L.J.P.F.^{1,4}

¹IMAR-CMA, Department of Earth Sciences, University of Coimbra, Portugal

²ppinto@dct.uc.pt; ³apereira@dct.uc.pt; ⁴luisneves@dct.uc.pt

Abstract

The Portuguese Energy Certification of Buildings System utilizes the European Union directive on the energy performance of buildings. This legislation also integrates indoor air quality parameters and states for radon an action level of 400Bq.m⁻³. Taking into account the fact that most buildings have no occupancy in the night period, with the HVAC systems off, the choice of the measurement protocol can be an important factor for the proper understanding of the indoor air quality. Portuguese measurement protocols set two different approaches; a main test conducted with continuous monitors for at least 60 minutes in the morning period, and/or a secondary test, conducted with passive detectors, for a period of not less than 30 days. The number of measurements is defined by taking into account the area and the number of floors of the building.

This work will show that 30 days measurements are a cost-effective procedure as a first approach, allowing the certification of a large proportion of buildings. Single hour follow-up measurements are only necessary in those cases where the action level was surpassed, and when building occupancy represents an important variable to the HVAC operating system.

A PILOT STUDY ON THE AIR QUALITY IN PASSIVE HOUSES WITH PARTICULAR ATTENTION TO RADON

A. Poffijn¹, C. Boulard², B. Dehandschutter¹, M. Roger³ and O. Tonet²

¹ Federal Agency for Nuclear Control, FANC, Brussels, Belgium

² Free University of Brussels, ULB, Brussels, Belgium

³ Hainaut Health Vigilance, HVS, Mons, Belgium

Abstract

Due to economical factors and partly also to the concern about climate change, the concept of the passive house construction ("passivhaus") is becoming more and more common in Belgium and other Central European countries. A pilot study in some 20 passive houses focusing on radon, airtightness and CO₂ has been organised in the southern part of Belgium, where significantly increased indoor radon levels occur regularly. Although the airtightness observed was always much higher than by traditional constructions, the radon level in one of the houses was over 700 Bq/m³. As the installation of a geothermal heating system is quite common for passive houses, it is currently investigated if a technical problem in its installation is at the origin of the observed high radon level. The measured CO₂ levels were slightly higher than expected and in no house the air quality could be classified as being good or excellent according to existing ventilation standards.

The observations indicate that the quality of the indoor environment in this new type of constructions has to be investigated in detail before it is becoming common practice.

EFFICIENCY OF RADON REMEDIATION IN SWEDISH HOUSES

Tryggve Rönnqvist
Landauer Nordic AB

Abstract

Measurement data from more than 1000 Swedish houses in which radon remediation has been done are compared with measurement data before the remediation in order to evaluate how much the radon levels have been reduced. The influence of different building construction parameters on the efficiency of the radon remediation was investigated.

In Sweden, a light-weight concrete based on alum shale has been used as building material up to 1975. This building material is called “blue concrete” and is a source of increased radon levels in Swedish dwellings. In particular, the efficiency of the radon mitigation was compared for houses with and without this building material. Methods to determine the magnitude of the problem from the building material are discussed along with how the methods for mitigation are influenced by the occurrence of “blue concrete” in a house.

CHEMICAL VAPOR INTRUSION-A NUCLEUS FOR CULTURAL CHANGE?

Henry Schuver¹ and Dan Steck²

1. U.S. EPA; Office of Resource Conservation & Recovery, Wash. DC.
2. Physics Department, St. Johns College, Collegeville, MN

Abstract

The intrusion of subsurface-contaminant chemical-vapors (in soil gas) into indoor air, via mechanisms nearly-identical to those of radon intrusion, is receiving growing attention and concern by affected communities and regulators. The RCRA cleanup program is proposing an approach integrating radon into the investigation and decision-making processes for chemically-contaminated sites/communities (including measurement of radon by building occupants). So far, these efforts, including the inevitable comparisons with higher (cancer) risk from radon, have raised significant interest in radon in people living in, and nearby, these communities. Nevertheless, it is observed that “society has a generally negative understanding or stigma for soil gas controls” and to address this cultural misunderstanding several approaches, including designating ‘Soil-Gas-Safe Communities’, have been proposed to highlight their desirability.¹ It is important for AARST members to be aware of this, as a joint effort could expand/improve cultural understanding of radon-controls and health.

¹ Schuver et al., *Radon & Chemical Contaminants in Indoor Air & “Soil Gas Safe” Communities* presentation at American Academy of Sciences International Environmental Conference, Houston TX, 2012

OBSERVATION OF TIME DEPENDENCE IN RADON EMISSIONS


Shirvel Stanislaus

Valparaiso University, Indiana, USA
Shirvel.Stanislaus@valpo.edu

Abstract

During the summer of 2011, radon concentrations were measured in 44 houses in and around Valparaiso, Indiana. The average concentration in the houses measured was higher than the concentration estimated for this area by the EPA. In most houses, the concentration was below the EPA limit. In a few houses concentrations greater than 100 pCi/L were observed. Some of these concentrations show an interesting time dependence of the radon emission. In several houses where the concentrations were high on average, measurements show that the concentrations appear to be high during the night. This effect is not understood at present. Data are being further analyzed and more data are also being taken to understand some of the observations. Preliminary results will be presented. The work was carried out using funds from a grant from the Wheat Ridge organization to Valparaiso University.

**NATIONAL RADON TECHNICAL ASSISTANCE IN SUPPORT OF
INDUSTRY AND GOVERNMENT**



Bruce Snead
Director, Engineering Extension Programs
Kansas State University
Manhattan, KS 66506

Abstract

KSU provides National Radon Program Services under an EPA cooperative agreement. These services include answering 4 toll free numbers, responding to email inquiries, conducting the national radon poster contest, and providing technical support to state radon programs and radon partner organizations.

Supporting industry and connecting to state programs is a key goal when interacting with the public, but can be made difficult by lack of knowledge on the part of the public, and lack of awareness of our services on the part of the industry and partner organizations. Testing results and protocol issues, difficult to mitigate houses, and personally relevant risk communication are all topics that require careful listening, revealing questions, and awareness of industry and state resources and capacity. This presentation will review the technical assistance facts and figures, identify points of controversy and conflict, seek feedback from partners and look ahead at conditions that will impact radon technical assistance services to the public.