RISK PERCEPTION AND DRIVING FORCES FOR INDOOR RADON REDUCTION ACTIVITIES

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ABSTRACT

The motivation for performing indoor radon reduction measurements or mitigation are generally communicated by the commercial radon industry on the basis of identifying and eliminating a potential health hazard. The role of the commercial indoor radon industry is complicated by the different perspectives of the problem that have developed for various interested parties. Interested parties include homeowners, building owners, building occupants, builders, architects, realtors, and lawmakers. Each of these groups make an intuitive risk/benefit decision regarding their options for dealing with an indoor radon problem, which extends well beyond the consideration of potential health risks. Issues considered to be important to each of these groups are presented and analyzed in the context of the relative cost/benefit to the individual group. The results are discussed in terms of the traditional risk communication techniques used by the industry. The analysis is subsequently used to develop and illustrate more effective risk communication techniques that address the issues perceived to be important for each group.

INTRODUCTION

Elevated indoor concentrations of ^{222}Rn in homes and workplaces around the world have been identified as a major radiation protection issue. On average, indoor radon concentrations account for more than half of the U.S. general population's radiation exposure [NCRP 1987] and a number of structures across the U.S. have demonstrated radon concentrations that are elevated to concentrations similar to occupational exposures which have clearly correlated with increased incidence of lung cancers[National Academy of Sciences 1988]. Elevated indoor radon concentrations are attributed with producing the second largest incidence of lung cancer, following smoking [U.S. EPA 1992]. Government agencies have initiated steps to reduce the public's exposure to this carcinogen by utilizing information campaigns designed to motivate members of the general public to determine their exposures and take action to reduce radon concentrations in their homes if they exceed 4 pCi L^{-1} [148 Bq m^{-3}]. The programs that have been used to inform and encourage the public to reduce their exposures, and coverage by the popular press have, however, not been particularly effective in motivating measurement and/or mitigation activities.

This paper discusses some of the reasons for the apathetic public response to indoor radon and presents improved techniques for communicating the scope of the problem that can be adopted to provide more meaningful input to the members of the general public. It is these members of the public who must understand the relevant aspects of radon risk assessments since they are ultimately responsible for making decisions for radon measurement and/or reduction.

TRADITIONAL RISK COMMUNICATION

Risks resulting from radiation exposures are typically developed and communicated in quantifiable terms such as absolute risk, relative risk, lives lost per year or years lost per lifetime, etc. Once quantified these risks can be readily compared in order to prioritize and develop comparisons of the risks resulting from a variety of activities or agents. Different techniques must be used to effectively communicate risk to different audiences [National

Research Council 1989]. This is particularly true for radiation, and in particular, the risks from indoor radon exposures. Health physicists, for example, prefer to express risk in numerical quantities of absolute or relative risks. This is not very useful for most other members of the general public because they lack the background to put the risks into the proper context. It is therefore quite common to illustrate the risks by developing a ranking of relative risks from a variety of activities and environmental agents. An effective example for the risks associated with indoor radon exposures is presented in the U.S. EPA's Citizen's Guide [3], which have been adopted for inclusion in state radon program and commercial radon measurement and mitigation company brochures. This provides a ranking of risks resulting from various levels of exposure to indoor radon relative to other hazards to which the public can more readily relate, such as fires, drownings, automobile accidents, etc., and put the risks in perspective.

Members of the radiation protection community are familiar with this methodology and have undoubtedly seen any number of risk tables (or even software packages) for a variety of types of radiation exposures over the years. These assist the public in developing an intellectual understanding of these risks, but we have come to recognize that the ultimate perception of risk is frequently more solidly based on the underlying feelings and emotions associated with an activity or agent, rather than an intellectual analysis [Johnson 1993].

PUBLIC RISK PERCEPTION

The Power Reactor Section of the Health Physics Society is currently reviewing the issue of risk communication and public perception and has consequently examined new strategies for risk communication, including the "Hazard + Outrage" formula developed by Sandman[Russell and Garry 1994, Hance et al 1990]. This formula is based on the observation that public risk perception is not confined to the quantitative risks, i.e. the "hazard", but also includes an outrage factor that is based strongly on an emotional perception of the activity or agent under consideration. Sandman presents twelve elements that contribute to the outrage factor. These elements are itemized below, along with an analysis of the public's general conception of indoor radon risks compares in each area. For each element of the outrage factor, the first component contributes to the perception of a safe activity while the second component contributes to the perception of a high risk activity.

Safe		Risky	General Public Perception of Indoor Radon Risks
Voluntary	vs	Coerced	Action to reduce indoor radon concentrations are voluntary since the decision is up to individual homeowners : contributes to the perception of indoor radon as a "low-risk problem."
Natural	vs	Industrial	The source of radon is the natural elements in the earth's crust, naturally occurring : contributes to the perception of indoor radon as a "low-risk problem."
Familiar	vs	Exotic	The risk occurs in a familiar environment, homes and workplaces, and while individuals may not be familiar with radon itself, the fact that it is naturally occurring limits the exotic connotations of the problem itself : contributes to the perception of indoor radon as a "low-risk problem."
Not Memorable	vs	Memorable	The fact that specific lung cancers can not be attributed to radon exposure results in no one being able to remember people who have died from radon exposure, making it generally not memorable : contributes to the perception of indoor radon as a "low-risk problem."

Not Dreaded	vs	Dreaded	In the context of issues presented by the popular press, radon is probably viewed as just another "carcinogen of the week" and is therefore not characterized strongly by either of these categories.
Chronic	vs	Catastrophic	By the nature of lung cancer induction, with latent periods of 20 years, radon is a chronic problem : contributes to the perception of indoor radon as a "low-risk problem"
Established	vs	Debated	Popular press presents this as a debated issue. The public, however, seizes on this element to categorize radon as a "low-risk problem," which contrasts with what would be predicted by Sandman, and provides a reason to put off taking any definitive action.
Self control	vs	Control by Others	Closely related to the elements of "voluntary vs involuntary" and "natural vs. unnatural". While the problem is beyond self control, it is not controlled by any other specific group of humans, and action to remediate it is under the self-control of affected persons : contributes to the perception of indoor radon as a "low-risk problem"
Fair	vs	Unfair	Related to the natural source distribution. Since there is no one but "mother nature" responsible for the problem it is generally regarded as neither fair or unfair: therefore not characterized strongly by either of these categories.
Moral	vs	Immoral	Related to the natural source distribution which consequently eliminates moral vs immoral issues. Although since nature and environment are considered "moral," shifts public opinion at least away from an immoral issue : contributes to the perception of indoor radon as a "low-risk problem"
Trustworthy	vs	Untrustworthy	Related to the natural source distribution which eliminates this element with respect to the source. It may, however, be argued that the radon measurement and mitigation industry have been portrayed as untrustworthy, which makes it riskier to take action than to do nothing : contributes to the perception of indoor radon as a "low-risk problem"
Responsive	vs	Unresponsive	Government agencies have been quite responsive to this problem; creating citizen's guides, establishing tollfree hotline numbers, and advertising campaigns. They have not created mitigation assistance programs, however, which permits the public to reason "how bad can it be" : contributes to the perception of indoor radon as a "low-risk problem"

Overall the issues that the general public use to evaluate the risks associated with an activity or environmental agent do not generate a single item in this list that indicates radon is a high risk problem. Most in

fact permit the public to view it as a low risk problem. The small "outrage factor" associated with indoor radon consequently greatly reduces the public's perception that indoor radon exposures, even to significantly elevated concentrations, does not pose a substantial risk. In contrast to the intellectual knowledge of associated risks, the lack of a significant perception of risk does not motivate members of the public to either measure their indoor radon concentrations or to mitigate when elevated concentrations are discovered.

THE REST OF THE STORY - BENEFITS

Health Physicists, and other professionals that deal with risk assessments, do not base decisions for dose reduction only on the risk, but consider the costs of implementing procedures to effect exposure reduction as well as the resultant benefits of these actions. Thus actions are taken only after a comprehensive cost/benefit analysis.

Important portions of the cost/benefit equation have in large part been left out of the presentations of risks to the public. The result is that members of the general public have been left to develop their own cost/benefit analyses. The additional cost/benefit factors that are not included in the risk communication form perhaps the most important component of motivating actions for indoor radon measurement and mitigation.

Although the perception of the risks posed by indoor radon concentrations may be based largely on emotion, the ultimate decision to take action is usually the outcome of a logical cost/benefit analysis. In our experience many individuals regard this as a "scientific" problem and typically approach it as such, which intensifies the intuitive/thinking aspects of the problem. Individual decisions result from a personal cost/benefit decision. While information programs attempt to provide the information required to reach a well informed decision, this information is not highlighted in the high profile advertising campaigns where the radon health risks receive practically all of the attention.

Previous illustrations show that the general public's overall perception is that the health risk from indoor radon is not a particularly great concern. Therefore, in order to promote well informed cost/benefit decisions, radon related information materials must emphasize benefits and costs that encompass factors beyond the health risks associated with indoor radon exposures. These should include financial considerations which are particularly strong incentives for many of the population groups that deal with indoor radon. The financial aspects of the problem frequently produce the most quantitative analysis in large segments of the population. Additionally, although it may be sufficient to view the general public as a single population when discussing and attempting to communicate radiation induced health risks, the financial aspects of indoor radon affect subsets of the general population very differently.

It is important to clearly address the issues of interest to subsets of the population in a clear and concise manner if one wishes to avoid forcing them to develop their decisions based on false impressions and incorrect information. Many of the considerations outside of the health risks vary greatly in their impact on sub-sets of the general population, therefore communication and appropriate information items need to be directed to these specific groups in order to ensure effective cost/benefit analyses.

Cost/Benefit Analyses

In order to demonstrate how the cost/benefit of performing radon measurements and mitigation can vary in significance to various sub-sets of the population, the following examples are provided. Each of the representative sub-sets of the population are affected by radon measurement and mitigation processes differently. For each group, the benefits and costs of taking a pro-active stance on indoor radon issues are presented. Some modifying factors that will affect the benefits and costs are also provided that should be incorporated into individual decision making processes.

Homeowners: performing radon mitigation in houses having elevated radon concentrations

Benefits: Reduced risk from lung cancer
Improved Salability and value of home

Cost: $ 1,000 - 2,000

Modifying Factors: Age of occupants (children)
Do occupants smoke
Available income

Occupants of Public Buildings: performing radon mitigation in buildings having elevated radon concentrations.

Benefits: Reduced risk from lung cancer

Costs: Indirect costs to public - use of public funds & tax dollars

Modifying Factors: Age of occupants (i.e. schools)
Length of exposure (i.e. day long, or for short periods)

Owners/Operators of Public Buildings: performing radon mitigation in buildings having elevated radon concentrations.

Benefits: Improved public/customer relations
Moral & legally bound to protect public

Costs: Reduction of existing budget dollars
Indirect - may impact future budgets

Modifying Factors: Age of occupants (i.e. schools)
Length of exposure (i.e. day long, or for short periods)

Homebuilders: incorporating radon resistant construction features in new houses built over elevated radon potential soils.

Benefits: Fulfills moral obligation to customers
Reduced liability
Improved marketing

Costs: $ 500 per house (approximately) increased housing cost
Result in decreased sales/adverse effects on business
(admission of a problem)

Modifying Factors: Perspective and education level of customers
Precedence for establishing builder liability

Architects and Construction Companies: designing and installing systems to reduce indoor radon concentrations in buildings built over elevated radon potential soils.

Benefits: Design and installation of systems increase work and profits

Costs: Assumed liability if the system is not successful

Modifying Factors: Perspective and motivation of customer
Experience with radon systems design and operation

Developers: Characterizing native sites for elevated radon potential soils.

Benefits: Reduced liability
Approval of financing

Costs: Substantial if site has high radon potential
Result in decreased sales/adverse effects on business
(admission of a problem)

Modifying Factors: Requirements of financial institutions

Realestate Agents: Ensuring that indoor radon measurements are performed prior to house sales.

Benefits: Provide improved/safer product
Improved credibility with buyers
Improved market value and profit margin

Costs: Additional time and effort
Possible complications with risk of losing sale

Modifying Factors: Buyer's agent or Seller's agent

Lawmakers: Passing legislation to promote measurement, mitigation, and radon-resistant construction.

Benefits: Increased safety of the public

Costs: Political:
Increased governmental regulation
Increased cost to some businesses
Redirection of government budget funds

Modifying Factors: Political climate/constituents
Percentage of jurisdiction positively/negatively affected

Communication of Cost/Benefit

From the examples listed above it is apparent that there may be additional benefits to be realized from taking action to measure and reduce indoor radon concentrations, beyond the improvement of indoor air quality and subsequent reduction of health risk to the occupants of affected buildings. Traditionally, however, the only benefit communicated is the reduction in health risks associated with reducing radon exposures. In other cases the costs and risks of taking action to measure and reduce indoor radon concentrations may appear to be high. It is therefore

important that we do not confine our communication to just the health risk, but also explicitly discuss other related risks and monetary costs, as well as the full range of benefits that can be realized from measuring and reducing elevated indoor radon exposures.

It is particularly important that all of the relevant information be provided because radon is one area of radiation protection where the general public actively participates in the cost/benefit decision making process. Additionally, because of the different costs that affect various segments of the population, it is necessary to appropriately tailor these communications to specific audiences. When other risks, costs, and benefits are added to the discussion, the audience can make better informed and more consistent decisions. Risk communications should therefore be developed for the major groups that can have the most impact on the public health and should:

1. Specifically illustrate the benefits to be realized.
2. Clearly identify modifying factors that should be considered.
3. Provide accurate financial costs.

Several brief examples are provided to illustrate additional information that should be provided to several groups that must deal with indoor radon issues, in order to help them better perceive the relevant aspects of the decisions that they face.

Homeowners

1. Tangible benefits can be realized which include
   - Improved resale value - appeals if expect to reside there short term.
   - Improved long term health of children
   - Improved personal health - appeals if expect to reside there long term.
   - Improved home safety and peace of mind

2. Factors that should be considered and factored into the decision
   - length of time expect to occupy the structure
   - average time of residence between moves
   - current age of occupants
   - smoker or non-smokers

3. Costs — Typically $1,000 to $2,000, depending on type & size of house

Note that this type of information is available in the EPA's Citizen's Guide, but some of the relevant topics do not find their way into the highlights when presented to homeowners.

Architects

1. Tangible Benefits
   - Additional work and increased billing
   - Improved product

2. Factors that should be considered and factored into the decision
   - Designed use of the building and the times of occupancy
   - Desires of the customer / building owner

3. Costs — Liability if post-construction radon concentrations are elevated, and therefore should spend time and research appropriate radon system designs.

Realtors

1. Tangible Benefits
   Providing the customer with a better and safer product
   Improved credibility and company integrity, particularly with buyers
   Increased market values and better commissions

2. Factors that should be considered and factored into approach
   If working with a buyer: ensure that radon testing has been performed or included in the sales contract.
   If working with the seller: ensure that radon testing has been performed when the house is initially put on the market.

3. Costs
   Additional time and effort on the part of agents (one more thing to check)
   Possible complicating factor with risk of losing a sale if it is not presented in a positive manner.

Similar analyses can be simply developed for other population subsets and tailored to present the positive gains that can be made by taking appropriate measures to deal with indoor radon problems.

SUMMARY

The possibilities of motivating the members of the general public to take action to identify or reduce elevated concentrations of indoor radon are likely to be much better if the associated costs and benefits are clearly illustrated to them in a positive manner. The nature of the indoor radon problem causes it to be interpreted as a low health risk problem by much of the general population. The "risk communication" of indoor radon must therefore extend beyond the presentation and analysis of health risk to encompass the additional benefits and costs that are included in the decision making process. Although the health risks from radon are similar for a broad portion of the public, the other costs and benefits that strongly influence radon measurement and mitigation vary significantly for the different businesses, customers, etc. that compose the general population. It is therefore necessary to target presentations to the major groups affected by elevated indoor radon concentrations since this is an area of radiation protection where members of the general public can and do develop their own risk assessments and decisions.

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