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LIABILITY FOR TOXIC RADON GAS IN RESIDENTIAL HOME SALES

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Accumulating evidence on indoor radon gas pollution of homes in the United States indicates that it may be the source of tremendous health problems. These problems include various types of cancer caused by exposure to the radioactive gas. The harm and potential harm resulting from this toxic exposure has not yet been addressed by the courts.

In this Article Professors Cross and Murray examine the scope of the radon problem and survey the common law for remedies and defenses available in a tort action brought on the grounds of radon contamination.

Because of the exposure already inflicted on our families, the pain we feel will never subside. My own home . . . has a radon level 100 times higher than the safe recommended guideline. Our homes are 7 times higher than the level at which a uranium mine must be shut down. . . . My four small children . . . have been exposed to [the equivalent of] 22 packs of cigarettes a day. . . for eight years now.

No one can fully understand the guilt and anguish that we have had to bear . . .¹

Radon (also known as "Rn") is an odorless radioactive gas commonly found in the atmosphere throughout the world. In the United States radon tends to be concentrated within buildings, such as homes.² Like other forms of radioactivity, radon can induce cancer. Indoor radon levels currently are causing as many as 20,000 lung cancer deaths every year in this country.³ Although

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1. See *Hearings On Radon and Indoor Air Pollution Before the Subcomm. On Natural Resources, Agriculture Research and Environment of the House Comm. on Science and Technology*, 99th Cong., 1st Sess. 107 (1985) [hereinafter *Radon Hearings*].

2. A report of the Environmental Protection Agency (EPA) recognized the danger:

Radon is a radioactive gas produced by the radioactive decay of radium-226, which occurs naturally in almost all soils and rocks. Radon is present in the atmosphere everywhere due to its release from radium decaying in the ground. Outdoor radon levels generally are low. Typical indoor levels are usually about five times higher than average outdoor levels, but can be over ten thousand times higher.

U.S. ENVIRONMENTAL PROTECTION AGENCY, REPORT TO CONGRESS ON INDOOR AIR POLLUTION AND RADON UNDER TITLE IV, SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 12 (April 1987) [hereinafter *EPA RADON REPORT*].

3. See *Radon Hearings*, *supra* note 1, at 1 (statement of Rep. James H. Scheuer of New York). While 20,000 is the EPA's upper estimate, some have suggested that as many as 30,000 deaths may be caused each year by radon. See Galen, *Lawyers Grapple With Radon Issue*, Nat'l L.J., July 21, 1986, at 1, col. 1. Even critics of these high estimates acknowledge that radon is responsible for

this problem has received relatively little publicity, the dimensions of indoor radon exposure may dwarf those of every other environmental pollution problem in the United States.⁴ The overall radiation exposure from indoor radon is far in excess of that from nuclear power plants,⁵ and one author has suggested that the existing indoor "radon levels are the radiation equivalent of having a Three Mile Island accident . . . occur in the neighborhood every week."⁶ Notwithstanding this magnitude of harm, there is very little government regulation of the indoor radon pollution problem.⁷ Consequently, individuals subject to hazardous levels of indoor radon in their homes must turn to the common law for remedies.

Indeed, homeowners increasingly are turning to litigation to remedy their perceived indoor radon problems. While a growing number of cases are being filed,⁸ however, most of the legal issues involved in radon-based actions remain unresolved. The two existing reported decisions failed to reach most of the critical liability questions.⁹ As a consequence, courts now are confronted with a new

10,000 deaths annually. Eckholm, *Radon: Threat Is Real, But Scientists Argue Over Its Severity*, N.Y. Times, Sept. 2, 1986, at C1, col. 1. Other studies, suggesting between 1,000 and 20,000 deaths, are summarized by the American Medical Association Council on Scientific Affairs. See *Radon in Homes*, 258 J. A.M.A. 668, 670 (1987).

4. See, e.g., Hanley, *Radon: For the Homeowner, Some Questions and Answers*, N.Y. Times, Jan. 1, 1987, at 39, col. 3. ("Federal and scientific experts agree that radon is a greater risk than more widely publicized threats like asbestos, toxic waste dumps and dioxin"); *Radon Detectors*, CONSUMER REP., July 1987, at 440, 442 ("[T]here is no doubt that the risks of radon vastly exceed the risks from aflatoxin, PCBs, nuclear wastes, and virtually all other environmental hazards"). Indeed, the indoor hazard from radon may exceed the risk from all outdoor pollutants combined. See also OFFICE OF TECH. ASSESSMENT, *ASSESSMENT OF TECHNOLOGIES FOR DETERMINING CANCER RISKS FROM THE ENVIRONMENT* 91 (1981) ("Doll and Peto estimated that 2% of cancer mortality, representing approximately 8,000 cancer deaths, can be attributed to industrial pollution of air, water and food . . .").

5. Galen, *Health Dangers that "Put Everything Else to Shame,"* Nat'l L.J., July 21, 1986, at 8 (quoting Bernard Cohen, a physics professor at the University of Pittsburgh, as stating that "radiation from nuclear power, radioactive wastes and nuclear accidents is just one thousandth the problem of indoor radon").

6. Nero, *The Indoor Radon Story*, TECH. REV., Jan. 1986, at 28, 28.

7. EPA disclaims authority to regulate indoor radon pollution. See Galen, *supra* note 3, at 8 (citing Richard Guimond, director of EPA's Radon Action Program). See generally GENERAL ACCT. OFF., *INDOOR AIR POLLUTION: AN EMERGING HEALTH PROBLEM* 11-18 (1980) (describing ineffectiveness of federal government efforts to respond to indoor air quality); Kirsch, *Behind Closed Doors: Indoor Air Pollution and Government Policy*, 6 HARV. ENVTL. L. REV. 339 (1982) (discussing indoor pollutants, reviewing applicable federal legislation, and proposing legislative reform). Congress has recently taken small preliminary steps to address the problem, by enacting the Radon Gas and Indoor Air Quality Research Act of 1986, in conjunction with the Superfund Amendments. This new law provides only for research, however, and contains no regulatory authority. See Radon Gas & Indoor Air Quality Research Act of 1986, Pub. L. No. 99-499, §§ 401-05, 100 Stat. 1613, 1758-60 (1986). Moreover, "the Reagan Administration has consistently dragged its feet on meeting the EPA's budget requests for radon projects." *Radon Detectors*, *supra* note 4, at 442. See also Galen, *supra* note 3, at 10, col. 2 (referring to the "government's sluggishness" in addressing indoor radon problems); GAO Says EPA Best Suited To Lead Effort To Control "National Problem" of Radon Gas, 17 ENV'T REP. (BNA) No. 11, at 407 (July 11, 1986) ("No coordinated federal agency strategy exists for indoor radon control.").

8. See Galen, *supra* note 3, at 8, col. 3 ("litigation concerning naturally occurring radon is steadily on the upswing"); Comment, *Radon Gas: Ramifications for Real Estate Transactions in Pennsylvania*, 91 DICK. L. REV. 1113, 1114 (1987) ("suits have been filed against contractors, and more suits can be expected").

9. In the first decision, *Wayne v. Tennessee Valley Auth.*, 730 F.2d 392 (5th Cir. 1984), *cert. denied*, 469 U.S. 1159 (1985), plaintiffs were wholly unsuccessful. In 1968, the Waynes began con-

and vexing "toxic tort" situation. This Article attempts to provide guidance for the resolution of liability and damage questions surrounding excessive indoor radon exposures.

Part I of the Article¹⁰ addresses the scope and sources of the indoor radon exposure problem. This section considers the source of the hazard, how residences may contribute to high exposure levels, the pattern of current exposure levels, and the risk presented from such current levels. Through such analysis, the degree of danger posed within an individual home may be determined. Part I also reviews available remedial measures for houses with radon problems and summarizes the efficacy and the cost of the various suggested approaches.

Part II of the Article¹¹ explores the potential liability attendant to excessive indoor radon concentrations. There are no established precedents permitting homeowners to recover for these exposures. Nevertheless, several theories of liability, including strict liability, implied warranty of habitability, negligence, and fraud are readily adaptable to the instant controversy. The promise of any given approach will necessarily depend on the facts of a given situation, but at least one of several common law theories should be available to most homeowners who are exposed to particularly high concentrations of radon in their residences.

Part III¹² discusses the types of damages available to successful plaintiffs. Although radon may expose persons to a greatly increased risk of future cancer, often it will be difficult to recover for this threat, except in exceptional cases. Plaintiffs have a better prospect of recovering for mental anguish suffered from the exposure and for the cost of future needed medical surveillance. In addition, homeowners should be able to recover some lost property damages or repair costs to correct the radon hazard in their homes. On occasion, such a plaintiff could even rescind the contract by which she purchased the home. Before addressing these legal implications, however, we begin by analyzing the indoor radon problem itself.

struction of their home in Tennessee. During construction, the Waynes purchased concrete blocks filled with phosphate slag, which were used in the construction of their basement. In 1969, the Waynes and their two children moved into the home and lived there until 1979, when they learned that the phosphate slag was emitting potentially harmful radiation. *Id.* at 394. In September 1979, the Waynes moved out of their home, on the advice of the Tennessee Public Health Department and EPA. *Id.* at 395. The Waynes sued Tennessee Valley Authority in 1981, alleging breach of implied warranty, negligence, and strict liability. The United States District Court for the Northern District of Mississippi dismissed all these claims, however, as time-barred under the Tennessee statute of limitations for product liability actions. *Id.* at 395, 399-402 (affirming district court). The United States Court of Appeals for the Fifth Circuit also affirmed dismissal on a separate cause of action for fraudulent concealment, holding that the TVA neither knew nor reasonably could have known of the radon hazard as early as 1969. *Id.* at 395-396.

A second case, *Brafford v. Susquehanna Corp.*, 586 F. Supp. 14 (D. Colo. 1984), was somewhat more successful. The reported decision permitted the plaintiffs to sue for future cancer risk, based on the probability that they already had suffered subcellular harm from radon exposure. *Id.* at 17, 18. Subsequently, plaintiffs settled for an undisclosed amount of money. Galen, *supra* note 3, at 10 (permitted settlement based on increased risk of developing cancer).

10. See *infra* text accompanying notes 13-107.

11. See *infra* text accompanying notes 108-256.

12. See *infra* text accompanying notes 257-365.

I. THE CAUSES, NATURE, AND EXTENT OF THE RADON HAZARD IN RESIDENTIAL BUILDINGS

To date, discussion of the radon problem has centered on generalized national statistics. More focus is required to determine the availability of legal remedies for individual instances of radon exposure. This section provides background on the nature of the carcinogenic hazard presented by radon, the degree of that hazard presented by individual residences, and the various potential sources of that hazard. This type of analysis is necessary for an individual homeowner to assess her risks and appropriate courses of action.

A. *The Nature of the Radon Hazard*

Uranium is a well-known element, commonly found throughout the earth's crust, which breaks down or "decays"¹³ first into Radium-226, which in turn forms Radon-222.¹⁴ Radon-222 ultimately breaks down into its own radioactive progeny or "daughters."¹⁵ The alpha and beta particles emitted by these elements, like all radioactive substances, damage exposed human tissue and may cause cancer to develop in such tissues.¹⁶ Radon exposure from outside sources is a risk common to all humanity, but is largely vitiated by natural dispersal of the harmful particles. In cases of inside radon exposure, the threat to individuals results from the entrapment and buildup of harmful particles within a structure. It is this buildup, which may result from several circumstances, that may damage humans.

Before assigning liability for radon damage, it is essential to identify the source of the harmful exposure. Although all radon exposure ultimately traces back to the earth, indoor radon may derive from three distinct sources: (i) building materials permeated with radioactive materials; (ii) radiation-containing water or natural gas used in the home; and (iii) the ground underlying the home itself. In individual instances, any one or more of these sources may create an indoor radon hazard.

13. All radioactive elements "decay" by releasing subatomic particles, thus transforming them into other somewhat more stable elements. For a readily comprehensible summary of this process, see the discussion in Kirsch, *supra* note 7, at 343 & nn. 29-30.

14. *Radon Hearings*, *supra* note 1, at 118. Sheldon Meyers, Acting Director of The Office of Radiation Programs in the EPA, has stated:

Radon is a radioactive gas formed by decay of radium which is formed in turn by the decay of uranium that is naturally present in rocks and soil in many parts of the United States. Since radium and uranium are common elements in rock and soil, radon is being constantly generated everywhere.

Id. at 117. See generally COMM. ON INDOOR POLLUTANTS, BOARD ON TOXICOLOGY & ENVTL. HEALTH HAZARDS, ASSEMBLY OF LIFE SCIENCES, NATIONAL RESEARCH COUNCIL, INDOOR AIR POLLUTANTS 58-62 (1981) [hereinafter NRC] (summarizing natural background sources of radiation and the production of radon); *Radon in Homes*, *supra* note 3, at 668.

15. The radon daughters are known as lead-214, bismuth-214, polonium-210, and polonium-214. See N. NAGDA, H. RECTOR & M. KOONTZ, GUIDELINES FOR MONITORING INDOOR AIR QUALITY 10 (1987) [hereinafter GUIDELINES]. Polonium-210 and polonium-214, combined with radon, present the greatest threat to human health. See R. WADDEN & P. SCHEFF, INDOOR AIR POLLUTION: CHARACTERIZATION, PREDICTION AND CONTROL 32 (1983). For a judicial summary of this process, see *Johnston v. United States*, 597 F. Supp. 374, 385-87 (D. Kan. 1984).

16. See I. TURIEL, INDOOR AIR QUALITY AND HUMAN HEALTH 37-38 (1985).

Building materials were first implicated as a significant source of indoor radon exposure in Europe.¹⁷ Concrete blocks or bricks used in construction are the most likely sources of radium in building materials.¹⁸ While ordinary concrete may not present a substantial radon hazard, materials produced from industrial residues occasionally may have highly elevated levels of uranium or radium.¹⁹ Notwithstanding these exceptional instances, however, experts now believe that "concrete could account for only up to [ten] percent" of indoor radon concentrations.²⁰ Studies on the contribution of concrete and other building materials to indoor radon generally concur that these products are not a primary source.²¹ Although individual episodes of high radon from building materials may exist, this source is not responsible for the majority of indoor radon exposure.²²

Water and natural gas also may contribute to indoor radon levels. Groundwater or gas in certain parts of the United States may contain high levels of radiation,²³ and human exposure may result during showers or at other times when these utilities are exposed to the air.²⁴ Water and natural gas are not the largest sources of indoor radon, and contribute perhaps no more than three percent of the average concentration found throughout the country.²⁵ In some instances, however, water may be a major contributor to high indoor radon exposures.²⁶

17. For a summary of the European experience with building materials, see NRC, *supra* note 14, at 63; Nero, *Airborne Radionuclides and Radiation in Buildings: A Review*, 45 HEALTH PHYSICS 303, 306-07 (1983).

18. See Nero, *supra* note 17, at 307; Nero, *supra* note 6, at 37.

19. See NRC, *supra* note 14, at 63 (noting particularly that concrete blocks containing phosphate slag derived from phosphate production in the southeastern United States may contain uniquely high levels of radioactive substances).

20. Nero, *supra* note 6, at 37.

21. See Ingersoll, *A Survey of Radionuclide Contents and Radon Emanation Rates in Building Materials Used in the U.S.*, 45 HEALTH PHYSICS 363, 367-68 (1983); Kahn, Eichholz & Clarke, *Search for Building Materials as Sources of Elevated Radiation Dose*, 45 HEALTH PHYSICS 349, 359 (1983). The Council on Scientific Affairs of the American Medical Association observed that "[b]uilding materials are believed to contribute only small amounts of radon, unless tailings from uranium or phosphate mining operations have been used in construction." *Radon in Homes*, *supra* note 3, at 669.

22. See Nero, *Indoor Concentrations of Radon-222 and Its Daughters: Sources, Range and Environmental Influences*, in INDOOR AIR AND HUMAN HEALTH, 43, 49 (1985) ("It is clear that materials utilized in a building structure can contribute to substantial indoor concentrations, although this is not usually the case . . .").

23. See, e.g., NRC, *supra* note 14, at 69. This appears to be a particular problem with well water in the state of Maine, where "[h]igh levels of indoor radon have been found . . . partly because of the large amounts of the gas in domestic water supplies." Nero, *supra* note 6, at 31.

24. See Brennan & Turner, *Defeating Radon*, SOLAR AGE, Mar. 1986, at 33.

25. Nero, *supra* note 22, at 50; see also E.P.A., Water Pollution Control: Natural Primary Drinking Water Regulations; Radionuclides, 51 Fed. Reg. 34836, 34842 (1986) (to be codified at 40 C.F.R. pt. 141) (proposed Sept. 30, 1986) ("2% to 5% is the drinking water contribution to average exposure for indoor radon levels").

26. Nero, *supra* note 22, at 50. Nero observes that "the very high water-borne concentrations that are sometimes found will contribute much larger airborne concentrations." He goes on to note that a substantial minority of homes in the United States ("about 1% of the entire housing stock") may have considerable waterborne exposure to radon. *Id.* at 51. On balance, water is "[p]robably more important than building materials, as a source of radon in certain parts of the housing stock." *Id.* at 50; see also *Radon in Homes*, *supra* note 3, at 669-70 (radon levels in water highest when water

By far the largest source of indoor radon appears to be radioactive elements in the ground beneath affected residences. There is now a virtual consensus that ground emissions are the largest source of indoor radon exposure levels.²⁷ Moreover, most of these radon emissions from the soil are purely natural and not related to human activity.²⁸ Although radium concentrations in the ground vary, virtually all soils emit some radon gas.²⁹ This gas may then diffuse into an overlying structure, through various pathways, and cause the structure to be contaminated.

Because the ground itself is such a paramount source of radon exposure, one might conclude that avoidance of high radon soil would solve the indoor air pollution problem. Certain geographic regions have been identified as being especially high in radon production.³⁰ The largest concentration of radon contaminated houses is on the East Coast—Pennsylvania, New York, New Jersey, parts of New England, Florida, and the Appalachian Mountains.³¹ Unfortunately, "radon problems aren't confined to such areas" and "[t]here is enough naturally occurring uranium and radium in many soils and bedrocks" to produce hazardous exposure levels.³² The risk of high indoor radon levels appears to be a nationwide phenomenon.³³ Moreover, the radium levels in the ground cannot explain the demonstrated higher concentrations found indoors.³⁴ It is known that radon levels may vary widely even among houses built in the same

supplied privately and in Appalachia, New England, and Piedmont; radon in water can account for up to 35% of the difference between indoor and outdoor radon levels).

27. See, e.g., *Radon Hearings*, *supra* note 1, at 184 (according to Richard Wilson, Professor of Physics at Harvard, "The real hazards, then, are building on ground with high levels of radon, such as on a geological fault, and inadequate basement sealing."); I. TURIEL, *supra* note 16, at 35 ("Researchers believe that, in most cases, the soil beneath a house is the major source of radon."); Mage & Gammage, *Evaluation of Changes in Indoor Air Quality Occurring Over the Past Several Decades*, in *INDOOR AIR AND HUMAN HEALTH*, *supra* note 22, at 15 ("Modern evidence suggests, however, that in general it is the radon in soil air that is the major source of indoor radon."); Walsh & Louder, *Radon*, in *INDOOR AIR QUALITY*, 143, 145 (P. Walsh, C. Dudley & E. Copenhagen eds. 1984) ("In the U.S., the main contributor to the Rn input into structures usually seems to be the underlying soil.").

28. In some instances, uranium mining or other activities have resulted in elevated surface radon concentrations. However, "[e]xperts and lawyers agree radiation levels from naturally occurring radon far exceed those from man-made sources" Galen, *supra* note 3, at 10, col. 4.

29. See Nero, *supra* note 17, at 310.

30. See, e.g., GEN. ACCT. OFF., *supra* note 7, at 4; DeBenedictis, *Manning the Radon Front in Pennsylvania*, E.P.A. J., Aug. 1986, at 6 (discussing the search for such radon "hot spots").

31. See Galen, *supra* note 3, at 8, col. 2.

32. Brennan & Turner, *supra* note 24, at 33; see also *Radon Hearings*, *supra* note 1, at 271 (EPA congressional question eliciting response that dangerously elevated radon levels "can occur in almost any location"). One study found indoor radon levels exceeding the EPA limit in 38 of the 50 states. See *Where Radon is Found*, Nat'l L.J., July 21, 1986, at 10 (MAP). In addition, homes in locations with high outdoor radon may have relatively low indoor levels. See *Radon Detectors*, *supra* note 4, at 440.

33. See Berreby, *The Radon Raiders: Turning Perils Into Profits*, N.Y. Times, July 26, 1987, § 3, at 6, col. 2 (radon's "occurrence is so frequent and so unpredictable that the E.P.A. recommends that every house in America be tested"); INDOOR POLLUTION L. REP., Aug. 1987, at 3 ("According to EPA Deputy Administrator James Barnes, 'These findings indicate that radon may be a problem in virtually every state.'"). The recent EPA RADON REPORT concluded that "[e]levated radon levels have been found in houses in many states—not only where suspected geological factors or the presence of uranium deposits suggest that radon might be a problem." EPA RADON REPORT, *supra* note 2, at 12.

34. See, e.g., Budiansky, *Indoor Air Pollution*, 14 ENVTL. SCI. & TECH. 1023 (indoor levels may

area. Consequently, there must be something in the building structure itself that concentrates indoor radon levels and thereby creates a hazardous situation.

B. *Housing as a Contributor to Radon Exposure*

Even when the source of radon is the soil and not building materials, a building may elevate indoor radon levels. Indoor exposures can be viewed as a function of two structural factors: (i) the levels of radon gas that enter the house and (ii) the degree to which that gas is trapped within the house. Individual building characteristics have an integral effect on both these factors.

Radon from underlying soil enters a building through the basement, if one exists, and the floor. Structural characteristics of the house affect the rate at which such gas may be able to enter:

The actual pathway by which radon enters a building from the soil appears to vary substantially with building design and construction practice. In houses with concrete basements that are closed to the outdoors, radon may enter by diffusion through the basement floor, by convection within basement walls and by movement through cracks and designed openings or penetrations in either of these components.³⁵

In short, "cracks" in the floor, whether intended or incidental, permit radon gas to enter houses.³⁶

Not only do structural factors, such as cracks and openings, enable radon to enter a house, these factors may affirmatively draw radon inside the building. As described by physics professor Richard Wilson of Harvard, "the major problem is entry of radon gas into the house from below—the house acts as a funnel, sometimes at a lower pressure than the ground, sucking gas from below."³⁷ Thus, pressure differentials among other factors may force underground radon upwards and into residential structures.³⁸ When this occurs, the structures are "actively drawing radon from the ground" at up to ten times the normal diffusion rate.³⁹ Installed equipment ranging from exhaust fans to fireplaces to water heaters may also contribute to this pressure-driven flow of radon into homes.⁴⁰

A second important factor contributing to indoor radon exposure levels is

be 20 times higher than outdoors); Walsh & Louder, *supra* note 27, at 150 ("It is clear that indoor Rn concentrations can often be a factor of 10 or more higher than outdoor concentrations.").

35. Nero, *supra* note 17, at 311. According to the AMA Council on Scientific Affairs,

Although it diffuses slowly, if at all, through a solid, thick concrete foundation, radon passes easily through cinder blocks; through openings or cracks in a foundation; through openings where water, sewage, or gas pipes enter a house; and into a crawl space and then into the living area when the earth is not well covered by a material such as concrete.

Radon in Homes, *supra* note 3, at 669.

36. See also Moeller & Fujimoto, *Cost Evaluation of Control Measures for Indoor Radon Progeny*, 46 HEALTH PHYSICS 1181, 1181 (1984) (Radon "can readily gain access to inside the building through cracks in the walls and floor, or through openings where pipe and electrical connections enter.").

37. *Radon Hearings*, *supra* note 1, at 184.

38. See Nero, *supra* note 22, at 48-49 (describing recent studies on the entry rate of radon into buildings).

39. Nero, *supra* note 6, at 37.

40. See Hanley, *supra* note 4, at 39, col. 1.

the rate at which radon is trapped and concentrated within a building. Home energy conservation measures, encouraged by the government in response to the 1973 Arab oil embargo, have been implicated as a major cause of high indoor radon exposures. By reducing ventilation to cut heating and cooling costs, efficient weatherization traps radon within a house and thereby increases indoor concentrations. The Environmental Protection Agency (EPA) has concluded that the Department of Energy's weatherization program could result in 10,000 to 20,000 additional radon-induced cancer deaths every year.⁴¹

Currently, a controversy exists regarding the degree to which these energy conservation measures increase indoor radon levels. Some studies have found little or no correlation between reduced ventilation rate and indoor radon concentrations.⁴² Others have concluded that "low infiltration, energy-efficient homes do not, in general, have indoor air quality problems."⁴³ These studies suggest that the rate of radon intake is a much more important determinant of indoor levels than is the rate of escape.

Nevertheless, it is undisputed that, for a given house with a given radon intake level, reduced ventilation will increase indoor radon concentrations. Radon levels will vary inversely with the ventilation rate.⁴⁴ Thus, a fifty percent reduction in ventilation will roughly double the indoor radon concentration.⁴⁵ A very recent study has concluded that "[w]eatherization of an existing residence that decreases infiltration by 25% from 1.0 to 0.75 hr⁻¹ increases the risk of fatal lung cancer by 37%."⁴⁶ Reduced ventilation for energy conservation or other reasons may not "cause" the presence of indoor radon, but it clearly may significantly aggravate any preexisting problem.

C. Indoor Radon Levels

Various differing units are employed for measuring the concentration of radon in air.⁴⁷ For purposes of uniformity, this Article uses the "WL" (working

41. See I. TURIEL, *supra* note 16, at 40. Another authority notes:

Inhaber and King assume that by 2020 U.S. housing will have an average of 0.6 air changes per hour, compared with a current average of perhaps 1.0. Statistically, this amount of house tightening will increase the number of lung cancers by 17,000 per year. Other studies find numbers in this same range.

Nuclear Power Engineering, POWER ENGINEERING, June 1984, at 18.

42. See Nero, *supra* note 6, at 37 ("To test this association, our group measured both the radon concentration and the ventilation rate in the houses we examined. The result was surprising: we found little or no correlation between the two."); Nero, *supra* note 22, at 45.

43. I. TURIEL, *supra* note 16, at 87.

44. See Nero, *supra* note 22, at 45; *Radon in Homes*, *supra* note 3, at 670.

45. See Nero, *Indoor Radiation Exposures From ²²²Rn and Its Daughters: A View Of The Issue*, 45 HEALTH PHYSICS 277, 281 (1983).

46. Brambley & Gorfien, *Radon and Lung Cancer: Incremental Risks Associated with Residential Weatherization*, 11 ENERGY 589, 599 (1986); see also Kirsch, *supra* note 7, at 346 ("Radon concentrations can be two to five times higher in energy-efficient homes than in conventional homes.")

47. A reader of the literature may find radon concentrations measured in nanocuries per cubic meter (nCi/m³), becquerels per cubic meter (Bq/m³), or picocuries per liter (pCi/L), with the latter being the most common. For simplicity, all these forms are converted to "WL"s within this Article. The reader should bear in mind, however, that this conversion depends on equilibrium assumptions and is not meant to be precise.

level) unit of measurement, which is employed by the EPA in setting standards for uranium miners.⁴⁸ This tool does not measure radon directly, but has the benefit of measuring the amount of human exposure to the actual harmful alpha radiation from both radon and its progeny.⁴⁹ Exposure to a WL for approximately 170 hours yields a cumulative exposure of one "WLM" (working level month).⁵⁰

Two recent surveys of national indoor radon levels have reached strikingly similar conclusions. A review of the literature by Anthony Nero of the Lawrence Berkeley Laboratory estimated that national median indoor radon levels were roughly 0.015 WL.⁵¹ A national survey, of smaller scale, by Professor Bernard Cohen of the University of Pittsburgh, likewise found an average concentration of 0.015 WL.⁵² The studies also revealed that a substantial minority of homes, numbering roughly one million, have average radon concentrations of 0.08 WL.⁵³ Furthermore, higher measurements ranging from 0.1 to 1.0 WL "occur with startling frequency."⁵⁴ Numerous other studies roughly confirm these results.⁵⁵

Although these figures may seem small, they may result in considerable cumulative indoor exposure to radon and its daughters. The average level found in United States homes yields an annual exposure of 0.2 to 0.3 WLM.⁵⁶ The higher levels found in roughly one million homes produce an exposure rate of

48. Assuming certain equilibrium conditions, 1 WL equates to 100 pCi/L of radon. See Hanchey, *Uranium Mill Tailings and Radon*, reprinted in *Uranium Ore Residues: Potential Hazards and Disposition Hearings Before the Subcomm. on Procurement and Military Nuclear Systems of the House Armed Services Comm.*, 97th Cong., 1st Sess. 505, 506 (1981) [hereinafter *Hearings on Uranium Ore Residues*]; see also Brambley & Gorfien, *supra* note 46, at 594 (employing WL measure). As discussed therein, the translation is inevitably an imprecise one because of possible variance in the equilibrium factor. One WL is also roughly equal to 100 nCi/m³ or 3700 Bq/m³. See GUIDELINES, *supra* note 15, at 10. The EPA, however, assumes different equilibrium conditions, under which one WL is roughly equivalent to 200 pCi/m³. See U.S. ENVIRONMENTAL PROTECTION AGENCY AND U.S. DEP'T. OF HEALTH AND HUMAN SERVICES, A CITIZEN'S GUIDE TO RADON: WHAT IT IS AND WHAT TO DO ABOUT IT 10 (Aug. 1986).

49. See *Oil, Chemical and Atomic Workers Int'l Union v. Zegeer*, 768 F.2d 1480, 1482 (D.C. Cir. 1985); see also Walsh & Louder, *supra* note 27, at 148-49 (discussing the derivation of WL from measured concentrations of radon and progeny).

50. See *Radon Hearings*, *supra* note 1, at 119 (statement of Sheldon Myers of EPA). When original sources express radon concentrations in other terms, we have converted them into their WL- or WLM-equivalent.

51. Nero, Schwehf, Nazaroff & Revzan, *Distribution of Airborne Radon-222 Concentrations in U.S. Homes*, 234 SCIENCE 992, 994 (1986). The authors estimated a weighted average of 1.42 to 1.54 pCi/L. *Id.*

52. Cohen, *A National Survey of ²²²Rn in U.S. Homes and Correlating Factors*, 51 HEALTH PHYSICS 175, 176 (1986). The actual estimate of Dr. Cohen was 1.47 pCi/L. *Id.*

53. Nero, Schwehr, Nazaroff & Revzan, *supra* note 51, at 995. Nero concluded that these homes have indoor radon levels of roughly 8 pCi/L; see also *Radon Hearings*, *supra* note 1, at 139 (statement of John P. Millhone, Director of the Office of Buildings and Community Systems of the Office of Conservation and Renewable Energy within the U.S. Department of Energy). Millhone states that these levels exist in "perhaps 2% of U.S. houses, over one million homes." *Id.*

54. Nero, *supra* note 22, at 43. Extremely high levels of radon may be limited to "hot spots" where the readings are attributable to uranium mining or unique geographical conditions. See Kirsch, *supra* note 7, at 344-45 & nn.37-39 (describing varying results in specific regions).

55. Many exposure studies are summarized in *Radon in Homes*, *supra* note 3, at 669.

56. Nero, *supra* note 45, at 278; see also Nero, *supra* note 6, at 36 (reducing the annual estimate to 0.25 WLM because 25% of Americans live in apartments where radon exposure is lessened by low ground contact).

nearly 2 WLM per year.⁵⁷ The highest indoor radon levels may produce exposures of more than 10 WLM per year.⁵⁸ The significance of these exposure levels, in terms of human health, are discussed in the following section.

D. *The Risk from Indoor Radon*

Many sources now have broadcast the news that indoor radon exposures may be responsible for 20,000 deaths annually.⁵⁹ In the context of civil liability, however, this overall death toll is less relevant than the degree of risk faced by a given individual in a given residence. This section explores these risks and the ability to identify a specific level that should be deemed "unsafe."

Scientists and government officials generally assume that there is no completely safe level of radon exposure. Any level of exposure to radiation such as radon, no matter how low, could possibly cause cancer.⁶⁰ Although this no threshold hypothesis is an unprovable assumption, it is relied on in virtually all government regulation of carcinogens,⁶¹ and the Supreme Court has approved its use in regulation.⁶² This conclusion, however, does not compel the total elimination of radon exposure. At very low levels, the amount of risk may be so small as to be de minimis and below public policy concern.⁶³

The task, therefore, is to define the minimum radon level that may cause significant harm to building occupants. Studies of the harms of radon exposure usually have relied on a significant body of exposure evidence gathered by measuring uranium miners. These miners had higher exposure levels than exposure levels normally associated with radon. The studies of radon risk have taken identified risk levels and extrapolated downward to the radon levels found in the indoor environment.⁶⁴ While some uncertainties remain in this risk assessment

57. Nero, Schwehr, Nazaroff & Revzan, *supra* note 51, at 995.

58. Nero, *supra* note 45, at 278-79.

59. See *supra* note 3.

60. See 52 Fed. Reg. 2822, 2824 (1987) (Federal Radiation Protection Guidance For Occupational Exposure) (concluding "there is no completely risk-free level of exposure"); 51 Fed. Reg. 45678, 45681 (to be codified at 30 C.F.R. § 57) (Mine Safety and Health Administration) (1986) (noting that "it is prudent to assume a non-threshold linear relationship for low cumulative radon daughter exposures"); see also I. TURIEL, *supra* note 16, at 38 ("It is assumed that there is no smallest or threshold dose for cancer induction Not all researchers agree with this assumption, but many do").

61. See Cross, *Beyond Benzene: Establishing Principles for a Significance Threshold on Regulated Risks of Cancer*, 35 EMORY L.J. 1, 3 & nn.9-10 (1986) [hereinafter *Beyond Benzene*] (summarizing government conclusions that "public health policy requires that we assume no threshold of effect for carcinogens"); Cross, *Section 111(d) of the Clean Air Act: A New Approach to the Control of Airborne Carcinogens*, 13 B.C. ENVTL. AFF. L. REV. 215, 220, 226 (1986). EPA's standard for indoor radon exposures also adopts this convention. See 45 Fed. Reg. 27370, 27371 (Environmental Protection Agency 1980) (to be codified at 40 C.F.R. § 192).

62. See *Industrial Union Dept. (AFL-CIO) v. American Petroleum Inst.*, 448 U.S. 607, 635-36 (1980) (plurality opinion). The assumption also has been approved for use in EPA's outdoor radon regulations. See *American Mining Congress v. Thomas*, 772 F.2d 617, 633 n.13 (10th Cir. 1985).

63. See *Industrial Union Dept.*, 448 U.S. at 653-655. See generally *Beyond Benzene*, *supra* note 61 (examining the use of and statutory requirement for a significant risk threshold for the regulation of carcinogenic substances).

64. For a summary of this risk assessment process, see I. TURIEL, *supra* note 16, at 38-40; Brambley & Gorfien, *supra* note 46, at 595-97; Harley & Harley, *Risk Assessment for Environmental Exposures to Radon Daughters*, reprinted in *Radon Hearings*, *supra* note 1, at 194-201.

process,⁶⁵ the procedure is regularly employed by expert government agencies and may even understate the true risks of indoor radon.⁶⁶ The result of this risk assessment for radon has produced the conclusion that a cumulative exposure to one WLM presents a lung cancer lifetime risk of at least one in five thousand.⁶⁷

From this risk assessment, one can roughly calculate the risk posed by specific houses. For the approximately one million homes with annual exposures of around 2 WLM, the individual risk from one year's residence is greater than one in twenty-five hundred. Most people live in a home for more than a single year, however, and the lung cancer risk of spending a lifetime in such a home is roughly one in fifty.⁶⁸ For the average home (with 0.3 WLM annual radon exposure) the total lifetime risk is approximately one in three hundred.⁶⁹ However small these risks may appear at face value, they vastly exceed the typical outdoor pollution risk controlled by the federal government.⁷⁰ More specifically, these risks are far greater than that allowed in the government regulations for radon in drinking water.⁷¹

Utilizing the available and acceptable risk estimates, it may be that even the average house presents an unreasonable hazard to residents.⁷² Other sources may also provide help in determining appropriate minimum safe radon levels. The table on page 698 lists some of the many available guidelines that might also be used to define "unsafe" levels of radon exposure.⁷³ These standards or rec-

65. See I. TURIEL, *supra* note 16, at 39-40. It is also significant to note that the radon estimates come from human epidemiological data. "Compared with the usual methods of calculating risks from animal studies, this is an unusually reliable source of data." Eckholm, *supra* note 3, at C1, col. 2; see also 51 Fed. Reg. 34056, 34057 (Environmental Protection Agency 1986) (to be codified at 40 C.F.R. § 61) (reviewing standards for outdoor exposure to radon daughters and emphasizing that "there is much less uncertainty in estimates of risk from radionuclide emissions because of the extensive data base on the effects of human exposure to radiation").

66. See *Beyond Benzene*, *supra* note 61, at 2 (discussing the adequacy of such risk analysis); see also I. TURIEL, *supra* note 16, at 38 ("U.S. government publications on health risk analysis accept this hypothesis."). Turiel notes that "[a]ctually, it may be worse than this. Some researchers argue that part of the lung cancer attributed to smoking has exposure to radon daughters as a co-factor." *Id.* at 40.

67. Different risk assessment models yield somewhat different results. The 1 in 5000 estimate is by the National Council on Radiation Protection. Other organizations, including EPA, have somewhat higher risk estimates ranging up to over one in 1500. See Harley & Harley, *supra* note 64, at 201 (summarizing the results of the varying models); see also *American Mining Congress v. Thomas*, 772 F.2d 617, 636 (10th Cir. 1985) (estimating the residual risk of lung cancer at 1.3 in 100 for 0.02 WL); Brambley & Gorfien, *supra* note 46, at 597 ("For an average dose of 0.25 WLM/yr, this value of risk per unit of exposure [100×10^{-6} fatal lung cancers/WLM] attributes about 5% of the observed number of fatal lung cancers in the United States to radon, which is not an unreasonable estimate in view of the significance of cigarette smoking."); Ellett & Nelson, *Epidemiology and Risk Assessment: Testing Models for Radon-Induced Lung Cancer*, in *INDOOR AIR AND HUMAN HEALTH*, *supra* note 22, at 79, 82-84 (reviewing studies of variations of risk coefficient by age).

68. See Nero, *supra* note 6, at 36.

69. Nero, *supra* note 6, at 36.

70. See, e.g., *Beyond Benzene*, *supra* note 61, at 22-30 (EPA regulates air pollution risks in excess of one in 100,000).

71. See Sharecoff, *E.P.A. Plans New Curb on Radioactive Water*, N.Y. Times, Sept. 5, 1986, at A17, col. 2.

72. As discussed above, the average house may produce a lifetime risk of 1 in 300, and a yearly risk of 1 in 15,000. For most environmental hazards, a risk of merely 1 in 100,000 is high enough to merit control measures. See *Beyond Benzene*, *supra* note 61, at 51-52.

73. This table is adapted from Hanchey, *Uranium Mill Tailings and Radon*, in *Hearings On*

Source	Standard
EPA uranium mining standards	0.3 WL - take prompt remedial action 0.04 WL - take remedial action
Sweden indoor standards	0.11 WL - maximum for existing buildings 0.02 WL - maximum for new houses
Union of Concerned Scientists recommendations	0.05 WL - remedial action indicated
Indoor standards in Florida	0.04 WL - remedial action indicated
National Council on Radiation Protection and Measurement	0.08 WL - remedial action indicated
Surgeon General's Grand Junction CO Guidelines	0.05 WL - remedial action required
Canadian Task Force on Radioactivity	0.07 WL - remedial action recommended
World Health Organization	0.01 WL - existing buildings 0.01 WL - new buildings
American Society of Heating, Refrigerating and Air Conditioning Engineers	

ommendations are all roughly consistent in suggesting that the average home (0.015 WL) does not require action, but that the more than one million high exposure homes (0.08 WL) should undergo some remedial action.

The EPA's own indoor radon guideline is somewhat stricter, recommending the mitigation of any indoor radon exposures in excess of 0.02 WL.⁷⁴ The Environmental Defense Fund (EDF) has criticized even this level as too high.⁷⁵ Moreover, EPA itself emphasizes that this level is neither "safe" nor "acceptab[le]."⁷⁶ Nevertheless, an estimated five to eight million homes exceed

Uranium Ore Residues, *supra* note 48, at 509; Brennan & Turner, *supra* note 24, at 35; Nero, *supra* note 6, at 40; *Radon In Homes*, *supra* note 3, at 670.

74. See EPA responses to congressional questions, in *Radon Hearings*, *supra* note 1, at 274 (describing this "remedial action level"). EPA has varied over time in its indoor radon recommendations, but a specific standard is promulgated for indoor radon concentrations in uranium mining areas. See 40 C.F.R. § 192.12(b)(1) (1987). This standard provides that a "reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL." *Id.*

75. See Letter from Robert E. Yuhnke, Attorney for the Environmental Defense Fund, to Rep. James H. Scheuer, reprinted in *Radon Hearings*, *supra* note 1, at 282-83. EDF argues that such a standard would create a "false sense of security" in homes below the 0.02 WL guideline. *Id.* at 282; see also *10 States To Receive EPA Aid in Program to Measure Radon Levels Inside U.S. Homes*, 17 Env't Rep. (BNA) 971, 972 (Oct. 24, 1986) (EDF attorney Robert Yuhnke criticizes EPA recommendation as several times too high).

76. *Radon Hearings*, *supra* note 1, at 275.

the concentrations of the EPA standard.⁷⁷

The degree of radon exposure that produces an unreasonable or unacceptable risk is still subject to much dispute. At present, there is a very plausible argument that even the average American house presents an undue risk of cancer from indoor radon. A consensus now exists that a significant percentage of the nation's overall housing stock poses unacceptable risks, in that several million homes exceed generally recognized exposure guidelines.⁷⁸ Although existing regulatory standards need not be dispositive for common-law torts, courts can be expected to use such standards as guidelines.⁷⁹ To date, one court has spoken on the issue. In *Union Carbide Corp. v. Industrial Commission*,⁸⁰ the Colorado Supreme Court held that exposure to 0.15 WLM of radon "would be sufficient to cause the disease [lung cancer] in the event of prolonged exposure," and therefore is sufficient for liability under the State's occupational disease act.⁸¹ While the presence of liability for indoor radon exposures will depend on factors other than risk, there is virtual unanimity in recognition of the widespread nature and severity of the residential radon hazard.

E. Control Measures for Indoor Radon

Assuming that a hazardous situation exists in a given house, the availability and effectiveness of remedial measures must be considered. Numerous different measures are available to reduce indoor radon concentrations. In most circumstances the application of one or a combination of these measures will reduce indoor radon levels significantly. The New Jersey Environmental Protection Commissioner has flatly declared that "virtually any house or building can be cleansed of potentially dangerous indoor levels of [radon] through sophisticated ventilation and sealing techniques."⁸² This section considers the efficacy and cost of various available remedial measures.

77. See Eckholm, *supra* note 3, at C1, col. 2-3 (referring to studies by EPA and by the Lawrence Berkeley Laboratory). EPA itself estimates that 8.5 million homes currently exceed this standard. See EPA RADON REPORT, *supra* note 2, at 12. Other studies have suggested that even more homes may exceed the EPA level. See *EPA Issues Radon Guidance to Homeowners Advising When Mitigation Efforts Are Needed*, 17 Env't Rep. (BNA) 596 (Aug. 22, 1986) ("up to 12 percent of the homes in the United States may have radon levels higher than what the agency considers 'safe'"). Perhaps even thirty million homes may exceed the EPA recommended level. See *GAO Says EPA Best Suited To Lead Effort to Control "National Problem" of Radon Gas*, 17 Env't Rep. 407 (BNA) (July 11, 1986) (study found that 30% of 40,000 tested homes exceed EPA recommendation).

78. See Hanley, *supra* note 4, at 39, col. 1 ("The Federal Environmental Protection Agency said in August that perhaps 8 million of the nation's 70 million homes had radon levels above its recommended guideline. Radon experts in the scientific community are more conservative, saying that the number may be closer to five million.").

79. See *Bennett v. Mallinckrodt, Inc.*, 698 S.W.2d 854, 861 (Mo. Ct. App. 1985). In *Bennett* the court authorized going beyond federal standards in establishing liability for radiation exposure. *Id.* at 861-62.

80. 196 Colo. 56, 581 P.2d 734 (1978).

81. *Id.* at 59, 581 P.2d at 735-36 (quoting *Climax Uranium Co. v. Smith*, 33 Colo. App. 337, 342, 522 P.2d 134, 136 (1974)).

82. Sullivan, *Radon Tests Are Urged For Homes in Parts of Jersey*, N.Y. Times, Sept. 13, 1987, at 62, col. 2.

1. Sealing of Entry Points

Much radon seeps into houses through cracks in the floor or walls. Radon entry may be limited by sealing these cracks and other possible entry points. Certain surface sealants may successfully stop the entry of radon if applied on cracks and around pipes and drains.⁸³ In uranium mining communities, where indoor radon exposures may be particularly high, "sealing of cracks has proved relatively successful in reducing radon levels."⁸⁴

Sealing entry points has some significant limitations as a complete solution to the indoor radon problem. First, sealing every possible entry point is difficult, and "[e]ven if 90 percent of the entry points are sealed, the house can still draw almost as much radon from the ground as it would through unsealed cracks."⁸⁵ Partly for this reason, one study of the effectiveness of control measures concluded that "sealing cracks is not particularly useful."⁸⁶ Second, the duration of the protection offered by sealing entry points has been questioned.⁸⁷ Although sealants provide no panacea for controlling indoor radon, this remedy sometimes will be useful; even critical studies concede that sealing entry points typically reduces indoor levels by thirty percent.⁸⁸ Though not completely effective, the use of sealants may also be the most cost-effective response to indoor radon, costing less than \$750 for a one-time application in a representative house.⁸⁹

2. Increased Ventilation

In some buildings, increased ventilation may be the most effective means of reducing interior radon concentrations. Increased ventilation may take the form of "deweatheringization," or removal of insulating items that reduced the home's original ventilation rate.⁹⁰ Increasing the number of air changes per hour (ach) will dissipate radon; for example, an increase from 0.75 ach to 1.0 ach could reduce radon concentrations and the concomitant cancer risk by over one-third.⁹¹ In many instances, however, such increased ventilation may be an "impractical remedy" because of increased energy costs or adverse effects on the

83. See Moeller & Fujimoto, *supra* note 36, at 1184; see also Nero, *supra* note 17, at 317 ("[s]ealing surfaces, filling holes with impervious materials, or stopping transport via installation of plastic or other barriers has proved effective in some cases that required remedial action").

84. Nero, *supra* note 17, at 311. See also Brennan & Turner, *supra* note 24, at 35 (listing "sealing floor slabs with polyurethane caulks" as one of several approaches that have worked with great success in both Sweden and the United States).

85. Nero, *supra* note 6, at 38.

86. Cohen, *supra* note 52, at 179.

87. The sealant itself may last no longer than five years. See Fujimoto & Moeller, *supra* note 36, at 1190. Additionally, new cracks may develop over time as the house settles.

88. See Cohen, *supra* note 52, at 179.

89. See Moeller & Fujimoto, *supra* note 36, at 1188; see also *Ways to make your house safer*, CONSUMER REP., July 1987, at 445 (estimating the cost at \$300 to \$500 and noting that "a skilled do-it-yourselfer should be able to handle smaller jobs").

90. Theoretically, ventilation could be increased at very little cost simply by opening windows in the home. This approach may be energy-expensive, present a risk to home security, and "wind shifts make it almost impossible to maintain a constant air-exchange rate over time." *Ways to make your house safer*, *supra* note 89, at 444.

91. See Brambley & Gorfien, *supra* note 46, at 599.

comfort of residents.⁹² Comparative studies show this ventilation option to be among the most costly, with annual costs of approximately \$500.⁹³ Some of these costs may be avoided, in cold climates, through use of ventilation with a heat exchanger that retains heat from outgoing air.⁹⁴ Although this frequently cited approach may be effective for individual buildings, the heat exchanger may be economically impracticable "for most of the country" and may not be effective in reducing high radon concentrations.⁹⁵

A more effective variant on increased ventilation involves installation of a powerful fan underneath the house, in the crawlspace or basement, where existent. This process pulls contaminated air outside and simultaneously corrects pressure differentials that might draw the air into the living areas of the home.⁹⁶ An EPA-sponsored study found this process to be uniquely effective in homes with especially high radon levels. The test procedure had remarkable success, lowering radon levels by more than ninety-seven percent in some instances.⁹⁷ Further research may be required to demonstrate the overall effectiveness of this approach, and costs are presently high,⁹⁸ but installation by the homeowner and efficiencies resulting from widespread application of the technique might bring "ultimate capital costs" down to a very competitive \$300 to \$600 per home.⁹⁹ This option would also involve annual operating costs estimated to be approximately \$140.¹⁰⁰

3. Air Cleaning

When indoor pollution cannot be cured with the above methods, a homeowner might choose one of a number of methods that directly remove contaminants from the indoor air. This is possible because radon decay products tend to cling to airborne particles, which may be filtered out of the air. Various indoor air cleaners are available, and cleaners in the category generally known as elec-

92. Nero, *supra* note 6, at 38.

93. See Moeller & Fujimoto, *supra* note 36, at 1188.

94. See I. TURIEL, *supra* note 16, at 95; Nero, *supra* note 6, at 38. This procedure also can be relatively expensive, however, ranging from \$273 to \$423 per year in one study. Moeller & Fujimoto, *supra* note 36, at 1188. Others have estimated the cost of purchase and installation at \$400 to \$1500. See *Ways to make your house safer*, *supra* note 89, at 444.

95. Nazaroff, Boegel, Hollowell & Roseme, *The Use of Mechanical Ventilation with Heat Recovery for Controlling Radon and Radon-Daughter Concentrations in Houses*, 15 *ATMOS. ENV'T.* 263, 269 (1981).

96. See Nero, *supra* note 6, at 38 (recommending this option for most homes with serious radon problems).

97. *Radon Hearings*, *supra* note 1, at 129. The homes originally had indoor radon concentrations as high as 7.4 WL and were reduced to levels of 0.02 WL and below. *Id.*

98. Costs for the demonstration projects, however, ranged up to \$10,000. *Radon Hearings*, *supra* note 1, at 130. EPA now estimates professional installation costs to be \$3000. See Hanley, *supra* note 4, at 39, col. 3. Consumers Union estimates that a "system would cost about \$1000 to \$2000 to install, and its fan would cost \$140 a year or less to run." *Ways to make your house safer*, *supra* note 89, at 445.

99. *Radon Hearings*, *supra* note 1, at 131. EPA's most recent analysis suggests that "costs of these techniques are expected to range from \$100 to \$5000 per home, with an average of approximately \$1000 per home." EPA RADON REPORT, *supra* note 2, at 18.

100. *Radon Hearings*, *supra* note 1, at 131.

trostatic precipitators can remove some radon daughters from indoor air.¹⁰¹ Studies indicate that some of these devices may remove as much as forty-five to eighty-five percent of the radon daughters found in a structure.¹⁰² Many experts are skeptical, though, about the overall effectiveness of these devices. Theoretically these devices could increase the radiation doses of building inhabitants.¹⁰³ At present, air cleaning is not regarded as an effective general solution to the indoor radon problem.¹⁰⁴

4. Summary

In most cases, some combination of the methods discussed above should be able to reduce indoor radon concentrations to acceptable levels.¹⁰⁵ Entry point sealing and ventilation appear to be the most promising methods. Moreover, reduction in radon concentrations usually can be accomplished at a relatively reasonable cost, without requiring structural modifications. In some cases, however, repair costs could mount to several thousand dollars,¹⁰⁶ and in other more extreme circumstances, there may be no effective remedy to high indoor radon concentrations.¹⁰⁷

II. ESTABLISHING LIABILITY FOR RADON CONTAMINATION

Radon is without question a major public health problem, for which injured individuals may seek remedies at common law. This section discusses possible causes of action for homeowners faced with radon contamination. No clear-cut

101. See I. TURIEL, *supra* note 16, at 98-99.

102. Moeller & Fujimoto, *supra* note 36, at 1186. These figures apply to unipolar ion generators. Traditional electrostatic precipitators were estimated to remove 23% of indoor radon. *Id.*

103. As explained by one commentator,

One seemingly obvious approach to controlling radon is to remove airborne particles—and hence the decay products that cling to them—with an air-cleaning device such as a fan coupled to a filter. This does succeed in lowering the *total* concentration of decay products. However, with fewer particles in the air to cling to, a larger fraction of decay products remain unattached. Unfortunately, these unattached products appear to cause a greater radiation dose, so the net effect of air cleaning is unclear. Control of indoor radon is better left to other techniques.

Nero, *supra* note 6, at 38; see also Jonassen, *Removal of Radon Daughters by Filtration and Electric Fields*, 7 RADIATION PROT. DOS. 353 (1984); Radon in Homes, *supra* note 3, at 671 ("air cleaning in some cases may increase radiation doses").

104. See, e.g., Brennan & Turner, *supra* note 24, at 37 ("the issue is complicated by the fact that after filtering, the type of radon daughters (known as 'unattached') left behind may be more harmful—reducing the effectiveness of the air cleaning. Until this is better understood, we do not recommend this approach.").

105. EPA concludes that "indoor radon levels can be reduced substantially at relatively low cost" but that "mitigation schemes are very house-specific, and more than one mitigation method may have to be used to reduce radon to an acceptable level in a given house." EPA RADON REPORT, *supra* note 2, at 18.

106. An EPA study of more elaborate radon reduction measures found costs ranging from \$4300 to \$15,700 per home. GAO Says EPA Best Suited to Lead Effort to Control 'National Problem' of Radon Gas, 17 Env't Rep. (BNA) 407 (July 11, 1986).

107. See Eckholm, *supra* note 3, at C1, col. 2 ("[t]hose with high levels will have to be repaired, at costs often ranging into the thousands of dollars; in rare cases, houses may have to be demolished."). In one reported instance, a homeowner spent "\$100,000 to pinpoint his problem and then reduce radon levels that surpassed by 14 times the EPA's maximum safety standard." Galen, *supra* note 3, at 8.

liability yet exists under any established theory. Depending on the facts of the individual case, homeowner plaintiffs may be able to recover under theories of strict liability, implied warranty of habitability, negligence, or even fraud. This section discusses the relevant legal standards for these varied theories of recovery and their applicability to indoor radon exposure.

A. *Strict Liability*

In some respects, strict liability offers the most promise for homeowners exposed to excessive indoor radon levels. This theory obviates the need to prove misconduct by defendants and focuses the court's attention on the status of the home itself. It has the further advantage of precluding contract-based defenses, such as disclaimers. Plaintiffs have several potential obstacles to overcome, however, before they may successfully maintain a strict liability action for radon exposure. These obstacles are analyzed below.

1. Application to Residential Housing

The tort concept of strict liability has been applied in a number of contexts, probably the best known of which is products liability. Under certain circumstances, a home may be found to be a product, in which case a strict liability standard will be available for radon actions. Strict liability in tort has been applied to builder-vendors¹⁰⁸ of housing since the 1965 landmark New Jersey case, *Schipper v. Levitt & Sons*.¹⁰⁹ The New Jersey Supreme Court in *Schipper* held a real estate developer strictly liable for the injuries of a sixteen month-old child who was severely burned as a result of a defective water heater. This was the first case in which a court applied the products liability doctrine to real estate defects.¹¹⁰ Since *Schipper*, many courts have followed that decision's rationale and have held developers liable for real property defects. Courts have adopted two distinct approaches to this liability. Some courts have developed a cause of action for strict liability in tort;¹¹¹ others have used the same reasoning to create an implied warranty of habitability.¹¹² Both theories of builder liability trace their origins to the *Schipper* case,¹¹³ which therefore assumes considerable im-

108. "Builder-vendor" has been defined as "one who buys land and builds homes upon that land for purposes of sale to the general public." *Elderkin v. Gaster*, 447 Pa. 118, 123 n.10, 288 A.2d 771, 774 n.10 (1972); see also *Park v. Sohn*, 89 Ill. 2d 453, 461, 433 N.E.2d 651, 655 (1982) (builder-vendor defined as "one who is engaged in the business of building, so that the sale is of a commercial nature, rather than a casual or personal one").

109. 44 N.J. 70, 207 A.2d 314 (1965). Another important early case is *Waggoner v. Midwestern Dev., Inc.*, 83 S.D. 57, 154 N.W.2d 803 (1967). In *Waggoner*, heavy rains caused flooding of the house, and the court held a builder-vendor liable under strict liability.

110. Hiner, *Strict Liability and the Building Industry*, 8 J. PROD. LIAB. 373, 373 (1985).

111. See *Kriegler v. Eichler Homes, Inc.*, 269 Cal. App. 2d 224, 74 Cal. Rptr. 749 (1969) (homeowner recovered in strict liability from builder for failure of radiant heating system); *Schipper*, 44 N.J. at 90-91, 207 A.2d at 325-26; *Patitucci v. Drelich*, 153 N.J. Super. 177, 379 A.2d 297 (Law Div. 1977) (cause of action in strict liability existed against builder of home with inadequate sewerage system); *Gay v. Cornwall*, 6 Wash. App. 595, 494 P.2d 1371 (1972) (homeowner recovered in strict liability for roofing and plumbing defects).

112. See *Gable v. Silver*, 258 So. 2d 11 (Fla. Dist. Ct. App. 1972); *Rutledge v. Dodenhoff*, 254 S.C. 407, 175 S.E.2d 792 (1970).

113. *Schipper*, 44 N.J. at 80-82, 207 A.2d at 320-21.

portance as a precedent for builder liability.

In *Schipper*, the lessee of a home built by defendants alleged negligence on defendant's part in failing to install an automatic mixing valve, which would have provided for a proper distribution of hot and cold water. The New Jersey Supreme Court found that defendant could be held liable for breach of its duty of care to those who would come into contact with its water system.¹¹⁴ Plaintiff also contended that defendant should be liable for the injuries due to a "breach of warranty of habitability where a dangerous condition causes injury to a subsequent occupant."¹¹⁵ The court found that both the implied warranty of habitability and strict liability were causes of action available to the plaintiff.¹¹⁶ The court discussed both theories, sometimes intermixing the two;¹¹⁷ yet the court clearly intended both theories to be available to homeowners.

The *Schipper* court emphasized a number of policy considerations that substantially influenced its decision. These included the relatively unequal bargaining position of the homeowner in relation to the builder;¹¹⁸ the homebuyers' reliance on the skill and representations of the builder;¹¹⁹ deep pocket considerations of risk spreading;¹²⁰ and the buyers' relative inability to protect themselves adequately from the risk of injury.¹²¹ The *Schipper* court also examined several leading product liability cases, including *Henningsen v. Bloomfield Motors Inc.*,¹²² *Santor v. A. & M. Karagheusian, Inc.*,¹²³ and *Greenman v. Yuba Power Products*,¹²⁴ and concluded that there was no significant difference between the mass production of homes and the mass production of automobiles. The court stated:

The public interest dictates that if such injury does result from the defective construction, its cost should be borne by the responsible developer who created the danger and who is in the better economic posi-

114. *Id.*

115. *Id.* at 88, 207 A.2d at 324.

116. *Id.* at 90, 207 A.2d at 325 ("[T]he warranty or strict liability principles of *Henningsen* and *Santor* should be carried over into the realty field . . .").

117. See Comment, *Strict Tort Liability to the Builder Vendor of Homes: Schipper and Beyond?* 10 OHIO N.U.L. REV. 103, 106 (1983). At one point in *Schipper* the court stated that "when a manufacturer presents his products for sale to the public he accompanies them with an implied representation that they are reasonably fit for the intended use, and he is subject to an enterprise liability." 44 N.J. at 90, 207 A.2d at 325. Later in the opinion the court more clearly identified the implied warranty of habitability, stating that "[w]hen a vendee buys a development house from an advertised model, . . . he clearly relies on the skill of the developer and on its implied representation that the house will be erected in reasonably workmanlike manner and will be reasonably fit for habitation." *Id.* at 91, 207 A.2d at 325.

118. *Schipper*, 44 N.J. at 91-92, 207 A.2d at 326. ("Buyers of mass produced development homes are not on an equal footing with the builder vendors and are no more able to protect themselves in the deed than are automobile purchasers in a position to protect themselves in the bill of sale.")

119. *Id.* at 91, 207 A.2d at 325-26.

120. *Id.* at 91-92, 207 A.2d at 326.

121. *Id.* at 91, 207 A.2d at 326.

122. 32 N.J. 358, 161 A.2d 69 (1960) (strict liability imposed for breach of implied warranty of merchantability in sale of automobile with defective steering mechanism).

123. 44 N.J. 52, 207 A.2d 305 (1965) (strict liability imposed on manufacturer of defective rug).

124. 59 Cal. 2d 57, 377 P.2d 897, 27 Cal. Rptr. 697 (1963) (strict liability imposed for a defective power tool).

tion to bear the loss rather than by the injured party who justifiably relied on the developer's skill and implied representation.¹²⁵

On its facts, *Schipper* appears to be a logical extension of strict products liability to real estate; however, the doctrine may not be applicable in all real estate situations. Clearly, not all builders are involved in mass production of homes. Thus, some of the rationale for strict liability in *Schipper* may not apply to a small or custom builder. In addition, the plaintiff's injury in *Schipper* was caused by a defective product (the water heating system); however, in the radon context, the injury arguably is not caused by a defective product, but rather by a naturally occurring phenomenon in concert with certain intrinsic characteristics of housing. Thus, the application of strict liability may become more problematic in our context. Future application of strict products liability in the case of indoor radon contamination must be examined somewhat more closely.

Section 402A of the Restatement (Second) of Torts provides that one who sells a defective product that is unreasonably dangerous is strictly liable for the damage caused by the product.¹²⁶ The first step in fully extending strict liability to the sale of real property is to determine whether real estate is a "product" within the meaning of section 402A. In *Schipper* the court analogized the mass production of Levitt's homes to automobile production.¹²⁷ Comment d of section 402A specifically refers to automobiles as products within the meaning of the section but gives no clear indication as to whether the drafters of the Restatement intended homes or buildings to be included as products.¹²⁸ Thus, the Restatement itself gives no clue whether a home is a product, and case law must be examined to determine a judicial definition.

The courts have looked to the policy rationales behind strict liability to evaluate the characterization of a home as a product.¹²⁹ Some of these policy considerations include: (1) concern for public health and safety;¹³⁰ (2) the in-

125. *Schipper*, 44 N.J. at 91, 207 A.2d at 326.

126. Section 402A of the RESTATEMENT (SECOND) OF TORTS provides:

Special Liability of Seller of Product for Physical Harm to User or Consumer:

(1) One who sells any product in a defective condition unreasonably dangerous to the user or consumer or to his property is subject to liability for physical harm thereby caused to the ultimate user or consumer, or to his property, if,

(a) the seller is engaged in the business of selling such a product, and

(b) it is expected to and does reach the user or consumer without substantial change in the condition in which it is sold.

(2) The rule stated in Subsection (1) applies although

(a) the seller has exercised all possible care in the preparation and sale of his product, and

(b) the user or consumer has not bought the product from or entered into any contractual relation with the seller.

RESTATEMENT (SECOND) OF TORTS § 402A (1965).

127. 44 N.J. at 90-92, 207 A.2d at 326.

128. RESTATEMENT (SECOND) OF TORTS § 402A, (d) (1965). See Comment, *supra* note 117, at 110-12 ("the plain words of the Restatement will not dictate the ultimate scope of strict tort liability").

129. "The central issue seems to be whether these factors [underlying strict liability] are present in the case and whether the policies of strict liability are advanced by characterizing a certain item as a product." Comment, *supra* note 117, at 112-13.

130. See *Greenman*, 59 Cal. 2d at 62-63, 377 P.2d at 900-01, 27 Cal. Rptr. at 700-01.

ability of the buyer to inspect and identify some potential defects in the product;¹³¹ (3) reliance by the buyer on the skill and expertise of the manufacturer;¹³² (4) deep pocket considerations of risk spreading;¹³³ and (5) mass production of the item.¹³⁴ After examination of these policies underlying strict liability, a growing number of courts have applied strict liability in tort to the sale of new homes, particularly if constructed by a mass production developer.¹³⁵ There is some remaining doubt as to whether a custom builder who only constructs and markets a few homes each year is selling a product within the meaning of section 402A.¹³⁶

In *Patitucci v. Drelich*¹³⁷ a New Jersey court held that a cause of action in strict liability existed against a defendant-builder who was not a mass builder of homes. The defendant was a developer of a tract of approximately twelve homes, one of which plaintiff bought. The sewer system proved to be inadequate and plaintiff sued defendant in strict liability. The court analogized plaintiff's situation to that of a consumer injured by a defective automobile, noting that in both cases the consumer is unable to fully inspect the product.¹³⁸ The court also considered the defendant's construction expertise as a factor in assessing liability—the defendant was in the business of selling homes, and thus the professionalism of the defendant was more important than the mass production factor.¹³⁹

131. *Schipper*, 44 N.J. at 91, 207 A.2d at 325.

132. See *Kriegler v. Eichler Homes, Inc.*, 269 Cal. App. 2d 224, 228-29, 74 Cal. Rptr. 749, 753 (1969); *Smith v. Old Warson Dev. Co.*, 479 S.W.2d 795, 799-801 (Mo. 1972).

133. *Schipper*, 44 N.J. at 91, 207 A.2d at 326.

134. *Kriegler*, 269 Cal. App. 2d at 228, 74 Cal. Rptr. at 752-53; *Schipper*, 44 N.J. at 90-91, 207 A.2d at 325-26.

135. PROSSER AND KEETON ON THE LAW OF TORTS § 104A (W. Keeton 5th ed. 1984) [hereinafter PROSSER AND KEETON] ("There is now a growing body of authority for applying strict liability in tort for physical harm to persons and tangible things to the sale of new homes by the housing merchant, especially those constructed by mass production developers . . ."). See, e.g., *Bastian v. Wausau Homes*, 620 F. Supp. 947 (N.D. Ill. 1985) (applying Illinois law and finding mass-produced home to be a product for strict liability purposes); *Blagg v. Fred Hunt Co.*, 272 Ark. 185, 612 S.W.2d 321 (1981) (holding that house is a product for purposes of strict liability law); *Kriegler v. Eichler Homes, Inc.*, 269 Cal. App. 2d 224, 74 Cal. Rptr. 749 (1969) (holding home to be product). In other cases, courts have identified some aspect of a house as a product for purposes of finding strict liability. See *State Stove Mfg. Co. v. Hodges*, 189 So. 2d 113 (Miss. 1966) (defective installation of water heater), *cert. denied*, 386 U.S. 912 (1967); *Hovenden v. Tenbush*, 529 S.W.2d 302 (Tex. Civ. App. 1975) (defective bricks used in construction).

136. See *Bastian v. Wausau Homes*, 620 F. Supp. 947, 950 (N.D. Ill. 1985) (court held strict liability applicable to mass-produced homes and distinguished Illinois precedent holding that strict liability was not appropriate for buildings that were not mass-produced).

137. 153 N.J. Super. 177, 379 A.2d 297 (Law Div. 1977).

138. *Id.* at 179-80, 379 A.2d at 298.

139. *Id.* at 179, 379 A.2d at 298. See *Hiner*, *supra* note 110, at 378; *Comment*, *supra* note 117, at 114-15 (The court basically disregarded the mass-produced factor). Two other cases have held a home to be a product based on the builder's skill and the difficulty of inspection rather than the mass-production of the homes. In *Smith v. Old Warson Dev. Co.*, 479 S.W.2d 795 (Mo. 1972), the court found that because of the nature of the structure, the purchaser must rely on the skill and representations of the builder rather than relying on personal inspection. Thus, the purchase of a home involves the purchase of "a manufactured product—[a] house." *Id.* at 799. The actual holding of *Smith* is stated in terms of implied warranty rather than strict liability. *Id.* at 796.

In *McDonald v. Mianeki*, 79 N.J. 275, 293, 398 A.2d 1283, 1292 (1979), the New Jersey Supreme Court held that the implied warranty of habitability "arises whenever a consumer purchases from an individual who holds himself out as a builder-vendor of new homes—regardless of whether he can be labeled a 'mass producer.'" Although this case does not specifically concern

The court in *Patitucci* stated that the sewer system was a "defective condition unreasonably dangerous to the user or consumer," and therefore a strict liability cause of action under section 402A existed.¹⁴⁰

Not all of the policy rationales for extending section 402A liability to the mass production builder may be applicable to the small custom home builder. Clearly the custom builder is engaged in the business of selling a "product": a home. Yet, the ability to absorb and reallocate a loss is not as readily available to the small builder as it is to the mass producer. Commentators have been critical of extending strict liability to these builders; as one stated,

To allow a judgment against this type of individual could result in the loss of his business and perhaps more. This result would do more than protect an innocent consumer. It would protect that individual to the detriment of another who is unable to shift the risk or to use a business loss.¹⁴¹

Nevertheless, even though the small builder does not have the loss shifting opportunities of the mass-producer, he is not totally without alternatives—he could purchase insurance that would reduce the hardship caused by liability, and he can raise any applicable defense such as assumption of the risk, product misuse, or comparative fault. Liability under section 402A for radon contamination should not hinge on whether a builder is a mass-producer.

If a builder is not a mass-producer, the courts will be faced with a choice that may require either placing liability on a small builder who is not able to bear or shift the loss as easily as the mass-producer, or denying recovery to a plaintiff who has been injured by a defective product. In the radon contamination context, the plaintiff's injuries are life-threatening, and public policy will not be well served by categorically exempting from liability builders who are not mass-producers.¹⁴² Aside from the public policy rationale and in either case, the consumer is relying on the skill and knowledge of the developer. The number of

strict liability, the court discusses many of the policy issues applicable to the determination of whether a home is a product—skill and knowledge of the builder, the ability of the builder to prevent defects, lack of bargaining position of the buyer, and the fact that the builder introduced the article into commerce. *Id.*

140. *Patitucci*, 153 N.J. Super. at 180, 379 A.2d at 299 (quoting RESTATEMENT (SECOND) OF TORTS § 402A (1965)).

141. Comment, *supra* note 117, at 122. See Hiner, *supra* note 110, at 381-89. Hiner argues that there are significant differences between the manufacturing process of a product and a building; these include (1) the uniqueness of most buildings, as opposed to mass-produced products; (2) most buildings are built at the direction of the owner/developer and the construction can be modified at the request of the owner, this type of negotiation is not possible in the manufacturing process of most products; (3) buildings have a substantially longer useful life and are expected to be used by a larger number of people than most mass-produced products, thus requiring differing maintenance and repair standards. *Id.* Hiner concludes that on the basis of these differences most buildings should not be considered products as to justify imposition of strict liability in tort unless public safety concerns outweigh these differences. *Id.* After considering the public policy considerations underlying strict liability, Hiner argues that strict liability is only applicable in real estate to mass-produced buildings. *Id.* at 394.

142. Comment, *supra* note 8, at 1130 ("Because radon has severe adverse health effects, society should place the burden where the least human exposure would result. Requiring builders to take preventative steps during the course of construction would result in less total exposure of home residents to radon gas.").

units produced should not be the crucial factor in determining the applicability of section 402A.¹⁴³

The injured plaintiff is not automatically guaranteed recovery even if the seller, whether a mass-producer or a custom builder, is constructing and marketing a product under section 402A. A plaintiff also must prove that a defective condition existed in the product at the time construction was completed and that the injury was proximately caused by that condition. In the radon context, this means the plaintiff must prove that the source of the radon contamination is a defective condition in the home.

2. Radon Contamination as a Defect

In order to establish liability under section 402A, the plaintiff must prove that the product was in "a defective condition unreasonably dangerous to the user."¹⁴⁴ Thus, the product must be dangerous in a way that subjects persons using the product to an unreasonable risk of harm. The product may be unreasonably dangerous and therefore defective for the following reasons:

(1) a flaw in the product that was present in the product at the time it was sold by the defendant;¹⁴⁵

(2) a failure by the manufacturer of a product to warn adequately of a risk or hazard related to the way the product was designed;¹⁴⁶ or

(3) a defective design for the product.¹⁴⁷

These three methods of evaluating whether a product is defective under section 402A must be examined to determine if a home contaminated by high levels of radon gas is an unreasonably dangerous product.

a. A Flaw in the Product

A flaw in a product has been defined as a condition in the product that was unintended and makes the product more dangerous than intended.¹⁴⁸ A flaw created in the construction process makes a product, as a matter of law, unreasonably dangerous because the product is more dangerous than intended.¹⁴⁹

143. Imposition of strict liability is further justified because the builder "stands in a better position to test for radon and to take remedial or preconstruction steps to prevent radon from becoming a problem in a home." Comment, *supra* note 8, at 1129-30. Moreover, "the cost of taking steps to lower radon levels in the course of construction is much less expensive than taking those same measures once the home is built." *Id.* at 1130.

144. RESTATEMENT (SECOND) OF TORTS § 402A (1965).

145. PROSSER & KEETON, *supra* note 135, § 99(1). See also *infra* notes 148-55 and accompanying text (discussing flaws in products).

146. PROSSER & KEETON, *supra* note 135, § 99(2). See also *infra* notes 156-64 and accompanying text (discussing failure to warn by the manufacturer).

147. PROSSER & KEETON, *supra* note 135, § 99(3). See also *infra* notes 165-94 (discussing what constitutes a defective design for the product and the state of the art defense).

148. Coca-Cola Bottling Works v. Lyons, 145 Miss. 876, 111 So. 305 (1927); MacPherson v. Buick Motors, 217 N.Y. 382, 111 N.E. 1050 (1916).

149. See generally Keeton, *Product Liability and the Meaning of Defect*, 5 ST. MARY'S L.J. 30 (1973) (most cases deal with interpretation of what is a defect); Owen, *Rethinking the Policies of Strict Products Liability*, 33 VAND. L. REV. 681 (1980) (the law currently is confused with many different tests for defectiveness).

The seller of the flawed, defective product is strictly liable for the consequences of the flaw.¹⁵⁰ This burden of proof is much easier for the plaintiff to meet than the burden of proof for negligence liability, because there is no need to prove that the defendant was negligent in creating or failing to discover the flaw.¹⁵¹

The obvious question in the radon context is whether radon contamination is a "flaw" in the product-home. Three obvious possible flaws may be the source of liability under this theory: (1) inadequate sealage; (2) inadequate ventilation; and (3) contaminated building products. First, inadequate construction processes may yield cracks or pressure differentials that allow radon gas to seep into the home.¹⁵² Second, a plaintiff may contend that inadequate construction processes "over-tightened" the house, failing to provide sufficient ventilation to provide a means of escape for the radon gas. Third, a builder may have used construction materials contaminated with high levels of uranium or radon.¹⁵³ Even without identifying the precise source of radon, the plaintiff may argue that high levels of indoor radon provide circumstantial evidence of a construction flaw. Preferably, a plaintiff will offer expert testimony as to the precise source of the radon for the purpose of proving that a flaw exists in a radon contaminated home. The expert evidence must show that the damage would not have occurred but for a flaw in the product.¹⁵⁴

Arguably, these construction processes also may be classified as design defects, and the outcome of the case may depend on how this issue is resolved. Plaintiffs' prospects for success will be improved if radon levels can be traced to identifiable product flaws. It often will be in the interest of builders to argue that if a defect exists it is, in fact, best characterized as a design defect. In this way they may be able to avoid liability, because they had no way of knowing that the risk existed. This is the so-called state-of-the-art defense, discussed below.¹⁵⁵

b. Design Defect, Failure To Warn, and the State-of-the-Art Defense

Even if the construction technique was flawless, homeowners still may invoke strict liability by showing a defect in the design of the house. There are

150. RESTATEMENT (SECOND) OF TORTS § 402A (1965).

151. PROSSER & KEETON, *supra* note 135, § 99(2). See also Henningsen v. Bloomfield Motors, Inc., 32 N.J. 358, 161 A.2d 69 (1960) (implied warranty of merchantability cannot be ignored when other express warranties are present).

152. Cracks in the foundation should be held to be a structural product flaw. In the past, courts have found liability whenever such cracks have permitted indoor flooding. See *Wawak v. Stewart*, 247 Ark. 1093, 449 S.W.2d 922 (1970); *Bethlahmy v. Bechtel*, 91 Idaho 55, 415 P.2d 698 (1966); *Elmore v. Blume*, 31 Ill. App. 3d 643, 334 N.E.2d 431 (1975).

153. Rather obviously, using dangerous products in the construction of a building is a flaw, as held in numerous asbestos cases. See, e.g., *County of Johnson Bd. of Educ. v. United States Gypsum Co.*, 580 F. Supp. 284 (E.D. Tenn. 1984); see also *Shooshanian v. Wagner*, 672 P.2d 455 (Alaska 1983) (subcontractor may be liable for installation of harmful formaldehyde insulation).

154. See generally Annotation, *Products Liability: Proof of Defect Under Doctrine of Strict Liability in Tort*, 51 A.L.R. 3d § 8 (1973) (proof of defect generally). "[T]he nature and quality of the circumstantial and other evidence that a court regards as sufficient to justify a finding that a flaw that was traceable to a product when possession was surrendered by a target defendant is of primary importance when the basis of recovery is a flaw in the product." PROSSER & KEETON, *supra* note 135, § 99(2).

155. See *infra* notes 165-194 and accompanying text.

basically two tests to determine if a product is unreasonably dangerous because of a design defect. The first is a consumer contemplation test. Under this test "a product is defectively dangerous if it is dangerous to an extent beyond that which would be contemplated by the ordinary consumer who purchased it with the ordinary knowledge common to the community as to the product's characteristics."¹⁵⁶ While it would appear that a radon-contaminated home certainly would be dangerously defective under this approach, some courts and commentators have harshly criticized some aspects of this test.¹⁵⁷ Today, the test most often utilized by the courts in evaluating unreasonably dangerous design defects is the risk-utility test.

Under the risk-utility approach, a product is defectively designed only if the danger of the product outweighs the usefulness of that product. As Prosser and Keeton state, "Under this test, a product can be said to be defective in the kind of way that makes it 'unreasonably dangerous' if a reasonable person would conclude that the danger-in-fact, whether foreseeable or not, outweighs the utility of the product."¹⁵⁸ While the benefits of homes and other types of housing are considerable, the utility of certain radon-enhancing designs are not. Without a doubt, the benefit of a home that has high levels of radon gas is substantially outweighed by the danger of death due to lung cancer. Today there are construction techniques that allow homes to be built with a substantially reduced chance of significant indoor radon concentrations.¹⁵⁹ Builders who do not utilize these techniques should be liable for damage and injuries resulting from preventable radon contamination.

When high radon concentrations are due to energy-conserving reductions in ventilation, a court conceivably could find that the benefits of saving energy

156. PROSSER & KEETON, *supra* note 135, § 99(3). See also RESTATEMENT (SECOND) OF TORTS § 402A comment i (1965) (article must be dangerous beyond expectations of consumer qualified by what is the ordinary knowledge of community regarding that product).

157. Prosser and Keeton identify three reasons why consumer contemplation is inadequate as a test for evaluating design defects: (1) under this test a victim could not recover if the design defect was open or obvious, or if the purchaser was adequately informed concerning the defect; (2) the test can lead to the characterization of a product as dangerously defective even though it clearly is not, as in a new drug that is valuable to humanity but may have adverse side effects on a few persons; and (3) the test is difficult to apply to real situations—what does a reasonable consumer actually contemplate? Does he contemplate unknown side effects or does he expect not to be affected by any adverse risk unknown to him? The test can be manipulated to reach any result that a court or jury wishes. PROSSER & KEETON, *supra* note 135, § 99(3). See also *General Motors Corp. v. Simmons*, 545 S.W.2d 502 (Tex. Civ. App. 1977) (court used the consumer contemplation test to hold GM liable for loss of plaintiff's eyesight when side window of automobile shattered and small, dull particles of glass lodged in his eye), *rev'd on other grounds*, 558 S.W.2d 855 (Tex. 1977).

158. PROSSER & KEETON, *supra* note 135, § 99(3). Prosser and Keeton identify three reasons for concluding that the danger, whether foreseeable or not, outweighs the products utility: (1) the harmful consequences resulting from the reasonably foreseeable uses of the product caused by the way the product was designed outweigh the benefits of the product measured in terms of human desires and needs; (2) although the harmful consequences do not outweigh the benefits, there are alternative, safer products available to serve the same human desires and needs; and (3) although the harmful consequences do not outweigh the benefits, there is a feasible method to design a safer product. *Id.*; see generally Keeton, *Torts, Annual Survey of Texas Law*, 35 Sw. L.J. 1, 9 (1981) (stating that "a product is unreasonably dangerous, and therefore defective if a reasonable person would conclude that the danger in fact, whether foreseeable or not, outweighs the utility of the product").

159. See *supra* notes 82-107, and accompanying text.

outweigh some risk of radon exposure. Even in this case, the energy efficient house still could be found to be dangerously defective because of the builder's "failure to warn" about a risk or hazard (radon) related to the way the product-home is designed.¹⁶⁰ These failure to warn cases have been in the forefront of much product liability litigation. In order to establish liability for failure to warn, the plaintiff must show that the manufacturer knew or should have known of the product's dangerous defect.¹⁶¹ No liability will be imposed if the defendant acted in a reasonable manner; that is, if he took the steps a reasonable manufacturer would take in presenting the product.¹⁶²

If the radon hazard was unknown at the time of construction, a builder may escape liability. Even in this situation, though, there also may be a continuing duty to warn if the danger is discovered after the product is sold.¹⁶³ The duty to warn, at the time of the sale or after the product is in the hands of the consumer, is predicated on the information available to the manufacturer.¹⁶⁴ Thus, in the radon contamination situation, the builder, at the minimum, has a duty to warn the homeowner of the dangerous defect at the time the builder learns, or should have learned, of the dangerous, defective condition. The question becomes at what point the court will impose knowledge of the defective condition on the builder.

Many courts have found that if a builder or manufacturer conformed with the "state of the art" at the time the product was put into the consumer's hands, then the product should not be considered unreasonably dangerous or, if considered defective, the defendant has an affirmative defense.¹⁶⁵ Thus, if a builder of a radon-contaminated home can show that the risk of harm was unknowable when the home was built, then the builder will not be held liable despite the danger of the product, under either the design defect or failure to warn theory.¹⁶⁶

160. PROSSER & KEETON, *supra* note 135, § 99(2).

161. See *Dalton v. Tulane Toyota, Inc.*, 526 F. Supp. 575, 578 (E.D. La. 1981); *Woodill v. Parke Davis & Co.*, 79 Ill. 2d 26, 33-34, 402 N.E.2d 194, 198 (1980).

162. Prosser and Keeton state:

Although this ground of recovery [failure to warn] is sometimes referred to as strict liability, it is really nothing more than a ground of negligence liability described as the sale of a product in a defective condition, subject, however, only to the defenses and other limitations on liability applicable to strict liability rather than negligence.

PROSSER & KEETON, *supra* note 135, § 99(2).

163. *Branniff Airways, Inc. v. Curtiss-Wright Corp.*, 411 F.2d 451 (2d Cir.) (manufacturer has duty to remedy defects not discovered until after sale), *cert. denied*, 396 U.S. 959 (1969); *Bell Helicopter Co. v. Bradshaw*, 594 S.W.2d 519 (Tex. Civ. App. 1979) (manufacturer has duty to prevent continued use of defective product). See Schwartz, *The Post-Sale Duty to Warn: Two Unfortunate Forks in the Road to a Reasonable Doctrine*, 58 N.Y.U. L. REV. 892 (1983).

164. Schwartz, *supra* note 163, at 894-97.

165. See, e.g., *Needham v. White Laboratories*, 639 F.2d 394 (7th Cir. 1981); *Karjala v. Johns-Manville Prods.*, 523 F.2d 155 (8th Cir. 1975); *Borel v. Fibreboard Paper Prods.*, 493 F.2d 1076 (5th Cir. 1973), *cert. denied*, 419 U.S. 869 (1974); *Woodill v. Parke Davis & Co.*, 79 Ill. 2d 26, 402 N.E.2d 194 (1980).

166. See PROSSER & KEETON, *supra* note 135, § 99; Comment, *'Beshada v. Johns-Manville Products Corp.': The Function of State of the Art Evidence in Strict Products Liability*, 10 AM. J. L. & MED. 93, 102-03 (1984); Note, *Rise of the Phoenix—Feldman v. Lederle Laboratories: From the Remnants of State of the Art Evidence Comes a New Standard for Design Defect—Failure to Warn Cases*, 16 U. TOL. L. REV. 1053, 1075 (1985).

By recognition of the state-of-the-art defense, the courts are moving away from a pure strict liability standard toward a more fault-based, negligence-type standard.¹⁶⁷ There is some confusion as to the exact parameters of the state-of-the-art defense. Most courts agree that the manufacturer's inability to prevent the defect from occurring will not excuse liability;¹⁶⁸ however, there is some diversity of opinion as to whether scientific inability to detect the danger in a product design excuses the defendant from liability.¹⁶⁹ There is also general agreement that a product cannot be regarded as defectively designed merely because some technological advance after the manufacture or sale of the product makes it possible to eliminate or substantially reduce the risk of injury. Most courts hold that the evaluation of whether a safer product could have been designed must be determined at the time the product was actually designed and marketed.¹⁷⁰ The defendant has the burden of proving that "the risk of harm was unknowable when the product was manufactured or sold."¹⁷¹

While the vast majority of courts in the country deny recovery if the manufacturer of a product can prove that the defect was undiscoverable given the level of scientific knowledge at the time the product was manufactured or marketed, the New Jersey Supreme Court in *Beshada v. Johns-Manville Products Corp.*¹⁷² rejected an absolute state-of-the-art defense in a strict liability action for failure to warn.¹⁷³ In *Beshada*, workers exposed to asbestos from the 1930s sought to recover from six asbestos manufacturers and distributors for personal injury and wrongful death resulting from the exposure. The plaintiffs argued

167. "[T]he substantive content of the analysis in failure-to-warn and design defect cases is identical whether the claim is predicated upon a negligence or a strict liability theory." Birnbaum & Wrubel, *The N.J. Supreme Court Breathes New Life Into State-of-Art Defense*, Nat'l L.J., Sept. 17, 1984, at 22, col. 4.

Prosser & Keeton state:

If inability to discover a risk or hazard related to product design is regarded as a defense, then it is true that the only practical difference between strict liability for design hazards using a danger-utility test and negligence is a change in the burden of proof. The defendant under so-called strict liability is required to prove both that reasonable or utmost care was exercised and that the risk was undiscoverable.

PROSSER & KEETON, *supra* note 135, § 99(2).

168. See *Barker v. Lull Eng'g Co.*, 20 Cal. 3d 413, 573 P.2d 443, 143 Cal. Rptr. 225 (1978); *Cepeda v. Cumberland Eng'g Co.*, 76 N.J. 152, 386 A.2d 816 (1978).

169. See generally Connolly, *The Liability of a Manufacturer for Unknowable Hazards Inherent in His Product*, 32 INS. COUNS. J. 303 (1965) (when it is scientifically impossible to know the risk, manufacturer cannot spread the risk and should not be liable for the defect); Willig, *The Comment k Character: A Conceptual Barrier to Strict Liability*, 29 MERCER L. REV. 545 (1978) (state-of-the-art defense closely related to comment k limitation of strict liability); Note, *supra* note 166, at 1075-76 (concept of state-of-the-art defense to avoid liability varies among the courts).

170. See PROSSER & KEETON, *supra* note 135, § 99, at 701; Comment, *supra* note 166, at 104-05; Comment, *Beshada v. Johns-Manville Products Corp.: Adding Uncertainty to Injury*, 35 RUTGERS L. REV. 982, 993-94 (1983).

171. See Comment, *supra* note 166, at 102.

172. 90 N.J. 191, 447 A.2d 539 (1982).

173. *Id.* at 209, 447 A.2d at 549. The court stated:

Failure to warn of a risk which one could not have known existed is not unreasonable conduct. But this argument is based on negligence principles. We are not saying what defendants should have done. That is negligence. We are saying that defendants' products were not reasonably safe because they did not have a warning.

Id.

that lack of warnings and safety equipment justified imposition of strict liability.¹⁷⁴ The defendants raised the state-of-the-art defense, claiming that during the time of production neither they nor the medical community could have known that asbestos posed a serious health threat.¹⁷⁵ The New Jersey Supreme Court held defendants liable for failure to warn of the product's dangers even though those defects were undiscoverable at the time the asbestos was marketed.¹⁷⁶ Thus, the court clearly rejected the state-of-the-art defense. The court in *Beshada* relied on three policies underlying strict liability as the rationale for rejecting the state-of-the-art defense in the failure to warn situation—risk spreading,¹⁷⁷ accident avoidance,¹⁷⁸ and simplification of the fact-finding process.¹⁷⁹

An observation must be made concerning the *Beshada* case. It involved a failure to warn, not a design defect situation. In fact, one year after *Beshada*, in *O'Brien v. Muskin Corp.*,¹⁸⁰ the New Jersey Supreme Court held that a defendant could introduce state-of-the-art evidence on the issue of a defective design.¹⁸¹ The court held that the jury could consider "risks that the manufacturer knew or should have known would be posed by the product."¹⁸² Thus, the court in *O'Brien* reintroduced state-of-the-art evidence into the risk-benefit analysis of a product. The utility of a product is based on the need for the product and possible alternatives, while the dangers of the product that the manufacturer knew or should have known about and the adequacy of warnings are part of the risk analysis.¹⁸³ *O'Brien* raised serious questions concerning the proper role of state-of-the-art evidence in design defect and failure-to-warn cases.¹⁸⁴

174. *Id.* at 197, 447 A.2d at 542.

175. *Id.*

176. *Id.* at 209, 447 A.2d at 549.

177. The New Jersey court found that the cost of the injuries should be imposed on the manufacturer who produced and distributed the product rather than the innocent victim, and that the imposition of liability would not result in a price increase beyond an economically efficient level, but would raise the price to reflect the cost of insuring against the possibility that the product might turn out to be defective. *Id.* at 205-06, 447 A.2d at 547.

178. "The 'state-of-the-art' at a given time is partly determined by how much industry invests in safety research. By imposing on manufacturers the costs of failure to discover hazards, we create an incentive for them to invest more actively in safety research." *Id.* at 207, 447 A.2d at 548.

179. The *Beshada* court noted:

[D]iscussion of state-of-the-art could easily confuse juries into believing that blameworthiness is at issue. Juries might mistakenly translate the confused concept of state-of-the-art into the simple question of whether it was defendants' fault that they did not know of the hazards of asbestos. But that would be negligence, not strict liability.

Id. at 208, 447 A.2d at 548.

180. 94 N.J. 169, 463 A.2d 298 (1983).

181. The defendants in *O'Brien* manufactured and distributed above-ground swimming pools which were fitted with vinyl liners. The plaintiff dove into the pool and reached for the bottom with his outstretched hands. His hands slipped on the vinyl lining and his head struck the bottom. The plaintiff argued that the slippery vinyl should not have been used to line the pool even though there was no alternative material available, thus the pool was defectively designed. *Id.* at 178-79, 463 A.2d at 302-03.

182. *Id.* at 183, 463 A.2d at 305.

183. *Id.* at 183-84, 463 A.2d at 305-06.

184. The court in *O'Brien* stated, however, that mere compliance with the state-of-the-art is not an absolute defense. The product may be in compliance with the state-of-the-art and yet fail the risk-

The state-of-the-art dilemma in the New Jersey courts appears to have been settled by the 1984 case, *Feldman v. Lederle Laboratories*.¹⁸⁵ The *Beshada* decision was virtually unanimously criticized,¹⁸⁶ and *O'Brien* only created more uncertainty in New Jersey products liability law.¹⁸⁷ *Feldman* involved a failure-to-warn action against a manufacturer of a prescription drug.¹⁸⁸ The New Jersey Supreme Court held that state-of-the-art evidence is relevant to the determination of defectiveness, and only knowledge that is "reasonably obtainable and . . . reliable" will be imputed to the manufacturer.¹⁸⁹ The *Feldman* court did not overrule *Beshada*, but limited it closely to its facts.¹⁹⁰ The court in *Feldman* stated, "If *Beshada* were deemed to hold generally or in all cases . . . that in a warning context knowledge of the unknowable is irrelevant in determining the applicability of strict liability, we would not agree."¹⁹¹ Thus, the state-of-the-art defense appears to be viable in strict liability actions for design defects or failure to warn.¹⁹²

The question now becomes whether a builder of a radon-contaminated home knew or should have known of the dangerous condition. Certainly, the builders of homes built within the past five to ten years in radon-prone areas should be aware of the problem and the deadly dangers. As the radon problem becomes more widely publicized, even builders in other regions of the country should be expected to investigate possible radon problems in their houses. A much harder question exists for homes built fifteen or more years ago, before the danger of indoor radon was widely known. These builders may be able to take advantage of the state-of-the-art defense to absolve themselves of strict liability to injured homebuyers. Clearly, today's builders in high radon concentration areas have a duty to construct homes with radon dispersement devices and to warn potential buyers of the dangers of radon contamination.

The perfect case for strict liability under prevailing principles would be one where: (1) the builder-vendor was engaged in mass production sales; (2) radon entered the house primarily through cracks in a faultily constructed basement; (3) the sale took place recently; and (4) indoor radon levels substantially exceeded applicable standards. Most cases will not present such optimal facts.

benefit analysis. State-of-the-art evidence is just one factor in the risk-benefit equation. *Id.* at 183-84, 463 A.2d at 305.

185. 97 N.J. 429, 479 A.2d 374 (1984).

186. See Berry, *Beshada v. Johns-Manville Products Corp.: Revolution—or Aberration—in Products Liability Law*, 52 *FORDHAM L. REV.* 786 (1984); Schwartz, *The Post-Sale Duty to Warn: Two Unfortunate Forks in the Road to a Reasonable Doctrine*, 58 *N.Y.U. L. REV.* 892, 901-05 (1983); Comment, *supra* note 166; Note, *Defeat for the State-of-the-Art Defense in New Jersey Products Liability: Beshada v. Johns-Manville Products Corp.*, 14 *RUTGERS L. J.* 953 (1983); Note, *supra* note 166.

187. See Note, *supra* note 166, at 1086-89.

188. The plaintiff suffered tooth discoloration from the drug, Declomycin. The plaintiff based the suit on the manufacturer's failure to warn of the tooth discoloration side effect. *Feldman*, 97 N.J. at 434, 435, 479 A.2d at 376-77.

189. *Id.* at 458, 479 A.2d at 388.

190. *Id.* at 455, 479 A.2d at 387.

191. *Id.* at 454-55, 479 A.2d at 387.

192. See also *Heritage v. Pioneer Brokerage & Sales, Inc.*, 604 P.2d 1059 (Alaska 1979) (permitting use of "scientific unknowability" defense).

Plaintiffs exposed to high radon levels have a good prospect of proving a product flaw, though, whenever foundation cracks are the source of a high indoor radon level. Proof of a design defect or failure to warn is promising for sales conducted after 1976.¹⁹³ A very high standard should be imposed for future construction, and the presence of high radon levels itself should provide presumptive evidence of a housing defect.¹⁹⁴

B. *Implied Warranty of Habitability*

*Schipper v. Levitt & Sons, Inc.*¹⁹⁵ is not only a landmark case in the development of strict liability in real estate transactions, but it is also a landmark in the area of implied warranty. The court in *Schipper* held that a builder impliedly warrants that the home he sells is "built in a workmanlike manner and is suitable for habitation." ¹⁹⁶ As stated previously, the court in *Schipper* interchanged strict liability and implied warranty in its analysis,¹⁹⁷ even though strict liability is based in tort law, while the implied warranty is based in contract. Despite its contract origins, many courts, as well as commentators, recognize that the implied warranty owes much to tort law, though no showing of negligence is required.¹⁹⁸ The implied warranty of habitability differs from strict liability in a number of ways, most notably in the elements of notice,¹⁹⁹ privity,²⁰⁰ and disclaimer.²⁰¹ These elements may raise serious obstacles to an implied warranty of habitability cause of action against a builder of a radon-contaminated home.²⁰²

Prior to the recognition of the implied warranty of habitability, the rule

193. The precise date after which builders "should have known" of the radon hazard will be subject to considerable dispute. In the context of fraud, one court has held that a defendant "did not know or have reason to know of the danger of radon gas in 1969, when the blocks at issue were sold, and did not know or have reason to know of such a danger until near the end of the 1970's." *Wayne v. Tennessee Valley Auth.*, 730 F.2d 392, 396 (5th Cir. 1984). Others might place the relevant date somewhat earlier. The federal government first began issuing reports on the indoor radon hazard in 1976. See, e.g., Fitzgerald, Guimond & Shaw, *A Preliminary Evaluation of the Control of Indoor Radon Daughter Levels in New Structures*, EPA No. 520/4-76-018 (1976), cited in NRC *supra* note 14, at 319.

194. Radon now has received considerable attention in even nonscientific sources, and the Environmental Protection Agency has issued free advice to builders on minimizing indoor radon concentrations. See N.Y. Times, Sept. 13, 1987, at 62, col. 5. Builders now should be on notice to avoid constructing houses with high indoor radon concentrations or, at minimum, to warn prospective buyers of the presence of such concentrations.

195. 44 N.J. 70, 207 A.2d 314 (1965).

196. *Id.* at 94, 207 A.2d at 327 (quoting *Carpenter v. Donohoe*, 154 Colo. 78, 84, 388 P.2d 399, 402 (1964)).

197. See *supra* notes 116-17 and accompanying text.

198. See *Berman v. Watergate West, Inc.*, 391 A.2d 1351 (D.C. 1978) (implied warranty and strict liability are "two labels for the same legal right and remedy"); *Wolfe v. Ford Motor Co.*, 6 Mass. App. Ct. 346, 376 N.E.2d 143 (1978) (implied warranty and strict liability are the same action); *Jacob E. Decker & Sons, Inc. v. Capps*, 139 Tex. 609, 164 S.W.2d 828 (1942) (warranty is implied on the basis of public policy rather than contractual liability). Professor Prosser has labeled the implied warranty "a freak hybrid born of the illicit intercourse of tort and contract." Prosser, *The Fall of the Citadel (Strict Liability to the Consumer)*, 50 MINN. L. REV. 791, 800 (1966).

199. See *infra* notes 212-16 and accompanying text.

200. See *infra* notes 217-20 and accompanying text.

201. See *infra* notes 221-24 and accompanying text.

202. See J. CALAMARI & J. PERILLO, *CONTRACTS* § 11-24, at 424-25 (1977) ("An action in

relating to the sale of real property was "caveat emptor."²⁰³ After World War II, the housing industry in this country underwent a great change. As one commentator stated, "the building industry outgrew the old notion that the builder was an artisan and took on all the color of a manufacturing enterprise, with acres of land being cleared by heavy machinery and prefabricated houses being put up almost overnight."²⁰⁴ With this change in the building industry, increasing pressure was brought to change or abandon the caveat emptor doctrine in favor of recognition of some type of implied warranty in the sale of new homes.²⁰⁵ Another factor in the development of an implied warranty concept in the sale of new homes was the preceding development of implied warranties in sales of personal property. Under the Uniform Commercial Code (UCC), the sale of personal property could carry implied warranties of merchantability and fitness for a particular purpose.²⁰⁶ The difference in treatment between personal and real property has been viewed as indefensible. One commentator noted the irony of a legal system that "offer[ed] greater protection to the purchaser of a seventy-nine cent dog leash than it [did] to the purchaser of a 40,000-dollar house."²⁰⁷

As a result of the increasing pressures to abolish the doctrine of caveat emptor, the majority of states adopted some type of implied warranty of habitability.²⁰⁸ While most courts recognize that the builder-vendor of a new home impliedly warrants some level of workmanship in the home, there is significant disagreement as to what level of workmanship the builder warrants. Some courts define the warranty as a guarantee that the home will have no defects that substantially impair the enjoyment of the home.²⁰⁹ Other courts analogize the warranty of habitability to the UCC's warranty of merchantability: the home must be of average quality, pass without objection in the trade, and be fit for the purpose of living in it.²¹⁰ Still other courts define the implied warranty more narrowly, finding it applicable only when the home is absolutely uninhabit-

strict tort liability is ordinarily preferable to a contract warranty action because questions of privity, notice and disclaimer are for the most part removed.").

203. The rule of "caveat emptor" (let the buyer beware) is thought to have originated in the late sixteenth century and was particularly prevalent in the nineteenth century when judges regarded the purchase of land as a "game of chance." Hamilton, *The Ancient Maxim Caveat Emptor*, 40 YALE L.J. 1133, 1187 (1931).

204. Roberts, *The Case of the Unwary Home Buyer: The Housing Merchant Did It*, 52 CORNELL L.Q. 835, 837 (1967).

205. See Bearman, *Caveat Emptor in Sales of Realty—Recent Assaults Upon the Rule*, 14 VAND. L. REV. 541 (1961); Dunham, *Vendor's Obligation as to Fitness of Land for a Particular Purpose*, 37 MINN. L. REV. 108 (1953); Haskell, *The Case for an Implied Warranty of Quality in Sales of Real Property*, 53 GEO. L.J. 633, 651 (1965).

206. U.C.C. §§ 2-314, 2-315 (1978).

207. Haskell, *supra* note 205, at 633.

208. Shedd, *The Implied Warranty of Habitability: New Implications, New Applications*, 8 REAL EST. L.J. 291, Table 1 at 303-06 (1980) (36 states and the District of Columbia recognize the implied warranty of habitability).

209. *Wagner Constr. Co. v. Noonan*, 403 N.E.2d 1144, 1148 (Ind. Ct. App. 1980).

210. *Petersen v. Hubschman Constr. Co.*, 76 Ill. 2d 31, 42, 389 N.E.2d 1154, 1159 (1979). See also *Berman v. Watergate West, Inc.*, 391 A.2d 1351 (D.C. 1978) (implied warranty extends to cooperative apartments); *Wimmer v. Down E. Properties, Inc.*, 406 A.2d 88, 92 (Me. 1979) (implied warranty that house built in "reasonably skillful and workman like manner" and suitable for habitation).

able.²¹¹ No matter how a court may specifically define the implied warranty of habitability, the radon-contaminated home should be found uninhabitable under any definition currently in use. Thus, the builder-vendor who sells a radon-contaminated home is likely to have violated an implied warranty of habitability.

Liability for breach of the implied warranty of habitability may not be automatic. Several jurisdictions have applied the UCC by analogy to real property situations involving the implied warranty of habitability.²¹² UCC section 2-607(3) requires that the buyer notify the seller of a breach of warranty within a reasonable time or the buyer will not be allowed to assert the breach in an action for damages.²¹³ Some courts have focused on the necessity of giving notice of the defect to the builder in order to allow him to attempt to repair the defect.²¹⁴ Other courts have emphasized the necessity of allowing the builder an opportunity to correct the defect.²¹⁵ Thus, a buyer wishing to bring a breach of implied warranty claim against the builder may have to give notice of the defect to the builder prior to the institution of the suit or be barred from recovery.²¹⁶

Most jurisdictions hold that privity of contract is a prerequisite for contract-based liability.²¹⁷ There is a growing trend, however, to abandon or limit the privity requirement in implied warranty cases. In 1976 the Indiana Supreme Court held that a showing of privity between the builder and purchaser was no longer necessary to maintain a cause of action for implied warranty of habitability.²¹⁸ The court limited its holding to latent defects that were discovered after the purchase. The court stated, "The standard to be applied in determining whether or not there has been a breach of warranty is one of reasonableness in light of surrounding circumstances. The age of a home, its maintenance, the use to which it has been put, are but a few factors entering into this factual determination at trial."²¹⁹ A growing number of courts have abolished the privity requirement for an implied warranty of habitability action;²²⁰ however, some

211. *Klos v. Gockel*, 87 Wash. 2d 567, 554 P.2d 1349 (1976) (en banc) (buckling, sinking, and cracking of patio slab and separation of door frame from wall did not affect habitability of home).

212. The UCC is not directly applicable to real estate transactions. See U.C.C. § 2-304 official comment 3 (1978) (transactions involving real property are outside the UCC). However, some decisions have used the UCC as a guideline for implied warranty of habitability liability. See *Capra v. Smith*, 372 So. 2d 317 (Ala. Civ. App.), *rev'd on other grounds*, 372 So. 2d 321 (Ala. 1978); *Tassan v. United Dev. Co.*, 80 Ill. Ct. App. 3d 581, 410 N.E.2d 902 (1980); *Matulunas v. Baker*, 569 S.W.2d 791 (Mo. Ct. App. 1978).

213. U.C.C. § 2-607(3)(a) (1978).

214. See e.g., *Wagner Constr. Co. v. Noonan*, 403 N.E.2d 1144 (Ind. Ct. App. 1980).

215. See *Pollard v. Saxe & Yolles Dev. Co.*, 12 Cal. 3d 374, 525 P.2d 88, 115 Cal. Rptr. 648 (1974); *Matulunas v. Baker*, 569 S.W.2d 791 (Mo. Ct. App. 1978).

216. In *Noonan*, 403 N.E.2d at 1149-50, the Indiana Court of Appeals indicated that receipt of the complaint by the defendant was insufficient notice.

217. See *Coburn v. Lenox Homes, Inc.*, 173 Conn. 567, 572-73, 378 A.2d 599, 601 (1977) ("This is not a mass marketing situation in which the defendant has attempted to insulate itself from liability behind a wall of intermediaries. Rather the defendant contracted directly with the original purchaser . . ."); *Oliver v. City Builders Inc.*, 303 So. 2d 466, 468 (Miss. 1974) ("It would be strange indeed, if, when the original purchaser conveyed the property to another, that his vendee could resort to the builder for damages for deficiencies in workmanship or materials which the original purchaser . . . accepted.").

218. *Barnes v. Mac Brown & Co.*, 264 Ind. 227, 342 N.E.2d 619 (1976).

219. *Id.* at 229, 342 N.E.2d at 621.

220. See, e.g., *Blagg v. Fred Hunt Co.*, 272 Ark. 185, 612 S.W.2d 321 (1981); *Redarowicz v.*

courts continue to recognize the privity requirement and bar implied warranty actions by subsequent purchasers.

Another potential bar to liability for breach of the implied warranty of habitability is the contract disclaimer. Although disclaimers are generally disfavored by the courts,²²¹ they are not held to be absolutely against public policy.²²² Many courts will enforce the disclaimer if it is conspicuous and clearly stated.²²³ Therefore, in the contract of sale, the builder can waive the implied warranty that the home is built in a workmanlike manner and fit for human habitation.²²⁴ The buyer who is injured by a defect in the home will not be able to recover under the implied warranty of habitability if an effective disclaimer is used. The disclaimer would be especially strong if it specifically referenced radon risks.

Finally, the implied warranty of habitability only guarantees that a home will be free from unreasonable defects.²²⁵ A home with high radon levels would seem to be unreasonably defective, for the health reasons discussed above. A builder might argue, however, that the home itself is habitable, and the risk exists due to external, natural factors beyond his control. As we have seen, however, indoor radon levels are largely dependent on characteristics of the home itself. Furthermore, this theory was clearly rejected in the Pennsylvania case of *Elderkin v. Gaster*.²²⁶ In *Elderkin* the court held that a home with an unhealthy water supply violated the implied warranty of habitability, even though the home itself and associated well were constructed soundly.²²⁷ Under this precedent, a builder may be found liable for locating a house at a site where the water

Ohlendorf, 92 Ill. 2d 171, 441 N.E.2d 324 (1982); *Barnes v. Mac Brown & Co.*, 264 Ind. 227, 342 N.E.2d 619 (1976); *Hermes v. Staidno*, 181 N.J. Super. 424, 437 A.2d 925 (Law Div. 1981); *Gaito v. Auman*, 313 N.C. 243, 327 S.E.2d 870 (1985); *Elden v. Simmons*, 631 P.2d 739 (Okla. 1981); *Terlinde v. Neely*, 275 S.C. 395, 271 S.E.2d 768 (1980); *Gupta v. Ritter Homes, Inc.*, 646 S.W.2d 146 (Tex. 1983); *Moxley v. Laramie Builders, Inc.*, 600 P.2d 733 (Wyo. 1979).

221. See generally Comment, *Liability of the Builder-Vendor Under the Implied Warranty of Habitability—Where Does It End?*, 13 CREIGHTON L. REV. 593, 594-96 (1979) (examining courts' treatment of disclaimer clauses in sales contracts for new houses).

222. See *Petersen v. Hubschman Construction Co.*, 76 Ill. 2d 31, 43, 389 N.E.2d 1154, 1159 (1979); *Conyers v. Molloy*, 50 Ill. App. 3d 17, 22, 364 N.E.2d 986, 989 (1977); *Gupta v. Ritter Homes*, 646 S.W.2d 168, 169 (Tex. 1983). One commentator has argued that a disclaimer of a warranty of habitability in the sale of new construction should be held unconscionable and against public policy. *Haskell*, *supra* note 205, at 654.

223. *Conyers v. Malloy*, 50 Ill. App. 3d 17, 21, 364 N.E.2d 986, 989 (1977) (disclaimer too general to put buyers on notice); *MacDonald v. Mobley*, 555 S.W.2d 916, 919 (Tex. Civ. App. 1977) (disclaimer not conspicuous).

224. But see Comment, *supra* note 8, at 1146-51 (arguing that disclaimer should be inapplicable in radon context, even when it is clear and unambiguous).

225. See, e.g., *Schipper v. Levitt & Sons, Inc.*, 44 N.J. 70, 92, 207 A.2d 314, 326 (1965); *Wagoner v. Midwestern Dev.*, 83 S.D. 57, 68, 154 N.W.2d 803, 809 (1972).

226. 447 Pa. 118, 288 A.2d 771 (1972).

227. *Id.* at 130, 288 A.2d at 777; see also Note, *Elderkin v. Gaster—The Pennsylvania Experience With Implied Warranties in Sales of New Homes*, 47 TEMP. L.Q. 172, 177-78 (1973) (The *Elderkin* court's broad language extends implied warranty of habitability to latent site conditions). It has been argued that a "primary function" of housing is the protection of inhabitants from the "elements," and builders should not complain when they have failed to do so. *Morrissey & Rupp, The Implied Warranty of Habitability: A Step Toward Protecting Home Buyers*, 23 TRIAL LAW GUIDE 137, 144-48 (1979) (quoting *Goggins v. Fox Valley Constr. Corp.*, 48 Ill. App. 3d 103, 106, 365 N.E.2d 509, 511 (1977)).

contained high radon levels. Liability for other cases of high radon exposure would be even clearer because, unlike in *Elderkin*, the house itself will contribute to the risk.

The owner of a radon-contaminated home may be able to bring a successful cause of action against the builder for breach of the implied warranty of habitability. Clearly, a home with unusually high radon levels is very hazardous and not fit for human habitation. An owner should first give notice to the builder of a radon problem and allow him an opportunity to repair damage and install devices that prevent future unacceptable radon concentrations. If the damage is not repaired, a suit for breach of the implied warranty of habitability is warranted. A disturbing trend in this area, however, is the ability of the builder to escape liability through a disclaimer. In the typical situation, the builder and the buyer do not share equal bargaining power. Even if the disclaimer is clear and conspicuous, it is unlikely that the buyer realizes that he is waiving his right to receive damages from the builder if the home is not fit for human habitation because of radon contamination. Presumably builders in states that allow disclaimers will incorporate a clear and concise disclaimer in all contracts of sale. As a result, a buyer may then have to rely on strict liability, negligence, or fraud as a basis for a cause of action against the builder.

C. Negligence

The purchaser of a home with high indoor radon concentrations may have a cause of action against both the builder and architect under a traditional negligence theory.²²⁸ To succeed the buyer must show that the defendant breached his duty to build the home in such a way so as to protect the purchasers from an unreasonable risk of injury, and that this breach of duty proximately caused the injury.²²⁹ The law of negligence imposes a duty of care upon the builder if a reasonable person in the same situation would have anticipated that the harm or injury was likely to result.²³⁰ Thus, the builder of a radon-contaminated home will be liable for the resulting injuries if he knew or should have known that the

228. See, e.g., *Stanley Consultants, Inc. v. H. Kalicak Constr.*, 315 F. Supp. 951 (E.D. Mo. 1974) (architect liable for negligent preparation of plans); *Palmer v. Brown*, 127 Cal. App. 2d 44, 58-59, 273 P.2d 306, 316 (1954) (architect liable for negligent inspection).

229. See, e.g., *Wright v. Creative Corp.*, 30 Colo. App. 575, 579-81, 498 P.2d 1179, 1181 (1972) (finding contractor negligent for installation of plate glass door rather than safety glass door); *Wagoner v. Midwestern Dev.*, 83 S.D. 57, 62, 154 N.W.2d 803, 806 (1967) (requiring knowledge that omission or act involved danger or harm to another); *ABC Builders, Inc. v. Phillips*, 632 P.2d 925, 935 (Wyo. 1981) (finding developer-builder-vendor liable for damages from a landslide). See generally PROSSER & KEETON, *supra* note 135, § 30 (elements of cause of action founded upon negligence); Annotation, *Liability of Builder—Vendor or Other Vendor of New Dwelling for Loss, Injury, or Damage Occasioned by Defective Condition Thereof*, 25 A.L.R.3d 383, 397-409 (1969) (builder-vendor liability for negligence in construction).

230. RESTATEMENT (SECOND) OF TORTS §§ 289, 298 (1965). See *Coburn v. Lenox Homes, Inc.*, 173 Conn. 567, 575, 378 A.2d 599, 603 (1977) ("It is clear that a defectively constructed house is likely to result in damage to the owner and there is no reason why the builder-vendor should not be liable for the effects of his negligence if they were foreseeable."); *Simmons v. Owens*, 363 So. 2d 142, 143 (Fla. Dist. Ct. App. 1978) ("In our judgment, building contractors should be held to the general standard of reasonable care for the protection of anyone who may foreseeably be endangered by their negligence.").

home was built in such a way as to allow radon contamination. Once again the state of scientific knowledge concerning radon will be important.²³¹ If a reasonable builder did not and could not have known of the possibility of radon contamination, then no duty of care will be imposed. A plaintiff, however, might demonstrate that the builder had a continuing duty to warn and was negligent for failing to inform the purchaser when the radon problem became known.²³² Nevertheless, negligence will present a more difficult burden of proof for a plaintiff to meet than the burden of proof of strict liability or the implied warranty of habitability.

If a court finds that a builder owes a duty to the purchaser of the home to protect against radon contamination, the plaintiff then must prove that the builder breached that duty by failing to exercise the care and skill of an ordinary builder under the circumstances.²³³ An alternative claim may be made against the builder for negligent siting of new construction in high radon areas.²³⁴ Houses built in violation of existing regulatory recommendations for radon might be considered presumptively to breach this duty of due care.²³⁵

Simply proving defendant's negligence is not sufficient, however; the plaintiff must also show that the failure to exercise due care in the construction of the home proximately caused the injury or damage.²³⁶ Builders faced with such a claim may raise a proximate cause defense, alleging that they are not responsible for the radon contamination. This defense would emphasize that, in most instances, radon gas does not enter the home as a direct result of negligent construction techniques, but rather through natural methods—radiation—

231. See *supra* notes 165-71 and accompanying text.

232. See, e.g., *Brown v. Merrow Mach. Co.*, 411 F. Supp. 1162, 1166 (D. Conn. 1976) (breach of continuing duty to warn of hazard from sewing machine could constitute negligence).

233. See, e.g., *Stephens v. Stearns*, 106 Idaho 249, 256, 678 P.2d 41, 48 (1984) (builder owes tenant common-law duty of ordinary care to perform in a workmanlike manner); *Mitchem v. Johnson*, 7 Ohio St. 2d 66, 73, 218 N.E.2d 594, 597 (1966) (vendor-builder has duty to perform with ordinary skill and care); *Northwestern Bell Tel. v. Henry Carlson Co.*, 83 S.D. 664, 669, 165 N.W.2d 346, 349 (1969) (remodeling contractor not liable for damages from seepage after unusually heavy rain, where he acted as an ordinarily prudent person would in similar circumstances). See generally PROSSER & KEETON, *supra* note 135, § 32 (defining the reasonable person standard).

234. See *Sabella v. Wisler*, 59 Cal. 2d 21, 28, 377 P.2d 889, 894, 27 Cal. Rptr. 689, 693 (1963) (negligent construction on unfit site); *Village Dev. Co. v. Filice*, 90 Nev. 305, 305, 526 P.2d 83, 84 (1974) (developer liability for negligent siting in flood plain); *Westwood Dev. Co. v. Esponge*, 342 S.W.2d 623, 628 (Tex. Civ. App. 1961) (developer liable for building house on landfill); *House v. Thornton*, 76 Wash. 2d 428, 435, 457 P.2d 199, 204 (1969) (developer liable for construction of house on site with unstable soil); *ABC Builders, Inc. v. Phillips*, 632 P.2d 925, 935 (Wyo. 1981) ("builder-vendor liable for damage from landslide because of duty to select a safe site for such construction").

235. Violation of an applicable statutory or administrative requirement, such as in a building code, is often considered to be negligence per se. PROSSER & KEETON, *supra* note 135, § 36, at 230 ("once [a statutory] breach has been established, probably a majority of the courts hold that the issue of negligence is thereupon conclusively determined"). See, e.g., *Gardenvillage Realty Corp. v. Russo*, 34 Md. App. 25, 39, 366 A.2d 101, 107 (1976). In the case of radon, however, the existing standards are not binding regulations but recommended guidelines, and thus this strict rule may not apply. The presence of such guidelines, at minimum, should provide persuasive evidence of negligence. See *Coleman v. Steinberg*, 54 N.J. 58, 65, 253 A.2d 167, 171 (1969) (even when "regulation is not applicable," its requirements "reveal an awareness by an expert public agency of the existence of a hazard").

236. PROSSER & KEETON, *supra* note 135, § 30. See *Porter v. Sadri*, 38 Wash. App. 174, 176-77, 685 P.2d 612, 613 (1984).

contaminated gas or water or the ground underlying the home.²³⁷ The plaintiff in turn must show that the builder's actions were the proximate cause of the excessive radon contamination and that contamination resulted in the plaintiff's injuries. In many cases, a plaintiff should be able to show that either negligent construction or negligent siting of the home exists. In addition, since radon is present at some level in all houses, the homeowner must show that elevated exposures are caused by negligent construction, siting, or design of the home. At present, it is unclear what threshold of radon exposure will be required, but a fair guess is that the plaintiff will be required to show exposures at least in excess of applicable standards.²³⁸

Another potential roadblock to a successful negligence action against the builder of a radon contaminated home is the requirement of privity. Remote purchasers, those not in contractual privity with the builder, and injured third parties may be prevented from bringing an action against the builder because of the lack of privity.²³⁹ While most jurisdictions have abandoned or modified the privity doctrine,²⁴⁰ not all courts have done so.²⁴¹

Clearly the negligence cause of action is not the best option available to the homeowner injured as a result of radon contamination. In defense, the builder can argue that he owes no duty of care to the owner with respect to radon exposure. If a duty is found, the builder may contend that he was not negligent under the prevailing knowledge and circumstances; and even if the builder is found to have negligently constructed the home, the remote purchaser may be barred from recovery due to a lack of privity with the builder. Nevertheless, in many cases negligence may provide an effective remedy for radon contamination.²⁴² Where privity bars an action, the remote purchaser's best option may be

237. See *supra* notes 36-40 and accompanying text.

238. While compliance with existing recommendations should provide some evidence that a builder-vendor was not negligent, this fact will not insulate defendants from liability. "Such a standard is no more than a minimum, and it does not necessarily preclude a finding that the actor was negligent in failing to take additional precautions." PROSSER & KEETON, *supra* note 135, § 36, at 233. Given the relatively high level of residual risk remaining even at the government-recommended levels, see *supra* note 60 and accompanying text, it is certainly plausible for a court to find negligence even for homes with lesser exposures.

239. The rationale for the privity requirement is that once the building is finished and accepted by the owner, the owner then becomes responsible for the defects even if caused by the builder's negligence. *Miller v. Davis & Averill, Inc.*, 137 N.J.L. 671, 674-75, 61 A.2d 253, 255-56 (1948).

240. *Woodward v. Chirco Constr. Co.*, 141 Ariz. 514, 516, 687 P.2d 1269, 1271 (1984); *Coburn v. Lennox Homes, Inc.*, 173 Conn. 567, 572, 378 A.2d 599, 602-03 (1977); *Oates v. JAG., Inc.*, 314 N.C. 276, 279-81, 333 S.E.2d 222, 224-25 (1985); *Terlinde v. Neely*, 275 S.C. 395, 398, 271 S.E.2d 768, 769-70 (1980). See generally Annotation, *Liability of Builder of Residence for Latent Defects Therein as Running to Subsequent Purchases from Original Vendee*, 10 A.L.R.4th 385, 393-402 (1981) (privity requirement for remote purchasers).

241. See *Simmons v. Owens*, 363 So. 2d 142, 143 (Fla. Dist. Ct. App. 1978) ("In our judgment, building contractors should be held to the general standard of reasonable care for the protection of anyone who may foreseeably be endangered by their negligence. But this is for our Supreme Court to decide. We urge it to do so." (citations omitted)).

242. See *Hiner, supra* note 110, at 397 ("[R]equiring injured plaintiffs to prove negligence against the contractor and architect will not divest them of effective remedies; the plaintiffs in *Schipper, Kriegler, and State Stove Manufacturing Co.*, who recovered against builders in strict liability actions, also made out causes of action in negligence.") (citations omitted).

a cause of action against the seller or builder based on fraudulent misrepresentation.

D. *Fraud*

Fraudulent misrepresentation or nondisclosure of the existence of dangerous levels of radon gas in the home by the builder, seller, or real estate broker who was involved in the sale of the home may provide a purchaser with a fraud action. At common law, the well-established elements for a cause of action in fraud or deceit are:

- (1) a false representation of a fact by the defendant;
- (2) knowledge of the defendant that the statement is false (or that he lacked of a sufficient basis for making the statement);
- (3) intent to induce the plaintiff to rely on the information;
- (4) justifiable reliance on the information, by the plaintiff; and
- (5) damage to the plaintiff as a result of his reliance.²⁴³

The builder, seller, and real estate broker who know of serious radon contamination of the home have a duty to disclose this information to the potential buyer.²⁴⁴ Yet, in many instances some of these potential defendants may not have actual knowledge of the radon problem. In any event, the plaintiff's burden of proof in a fraud action may seriously inhibit the viability of this remedy for radon contamination. The chances of a successful cause of action in fraud or deceit is diminished considerably, if the owner of a radon-contaminated home must prove that the defendant *knew* of the degree of radon contamination at the time of the sale of the home.

Many courts today, however, will hold the defendant liable for negligent misrepresentation. The basic difference between intentional and negligent misrepresentation is that the plaintiff does not have to prove that the defendant made the misrepresentation with an intent to deceive or with knowledge of the falsity of the statement.²⁴⁵ Thus, even if a statement is made with an honest belief that it is true, it may provide the basis of a cause of action for negligent misrepresentation.²⁴⁶ Under this standard, once a builder, seller, or broker makes a statement concerning radon contamination, it must be accurate.²⁴⁷

This does not solve the problem, for in many cases the defendant will have

243. PROSSER & KEETON, *supra* note 135, § 105, at 728.

244. See, e.g., *Reed v. King*, 145 Cal. App. 3d 261, 265-67, 193 Cal. Rptr. 130, 131-33 (1983) (broker knew that home was site of multiple murder and should have disclosed that fact to buyer); *Lingsch v. Savage*, 213 Cal. App. 2d 729, 735-36, 29 Cal. Rptr. 201, 204-05 (1963) ("[W]here the seller knows of facts materially affecting the value or desirability of the property which are known or accessible only to him and also knows that such facts are not known to, or within the reach of the . . . buyer, the seller is under a duty to disclose them to the buyer.").

245. See *Lyons v. Christ Episcopal Church*, 71 Ill. App. 3d 257, 259-60, 389 N.E.2d 623, 625 (1979); *Berryman v. Reigert*, 286 Minn. 270, 275-76, 175 N.W.2d 438, 442 (1970).

246. Prosser and Keeton state that "[a] representation made with an honest belief in its truth may still be negligent, because of lack of reasonable care in ascertaining the facts, or in the manner of expression, or absence of the skill and competence required by a particular business or profession." PROSSER & KEETON, *supra* note 135, § 107 (citations omitted).

247. Cf. *Lyons v. Christ Episcopal Church*, 71 Ill. App. 3d 257, 259-60, 389 N.E.2d 623, 625

made no affirmative statements concerning radon contamination. In fact, the defendant may not have had any idea that a possible problem existed. The question then becomes one of constructive knowledge; whether the builder, seller, or broker can be liable for failure to disclose a condition of which she was unaware.

In many instances, the cause of action will turn on whether the silence of a defendant can be deemed to be fraud.²⁴⁸ As a general rule, a seller of real property must disclose latent defects of which he has knowledge or which are reasonably discoverable.²⁴⁹ Clearly, a real estate broker must disclose latent defects which are within his knowledge;²⁵⁰ however, there is much confusion as to what is the broker's duty to the purchaser concerning latent defects which are not within the broker's actual knowledge.²⁵¹ Radon concentrations should be considered such a latent defect.²⁵² For housing transactions of a decade or more ago, brokers, vendors, and others may not be expected to have checked for a radon problem. Concerning more recent sales, however, the courts may hold that high radon levels were reasonably discoverable²⁵³ and that the defendants are liable for constructive knowledge of the risk.²⁵⁴ At a minimum, as knowledge of radon and its effects on residential real estate grows, the builder, seller, and real estate broker of homes in radon-prone areas must be expected both to determine if a radon problem exists and to disclose that problem to potential purchasers.²⁵⁵

Certainly, as a matter of course, builders in new home sales and real estate brokers in resale homes will want to suggest to the buyer that a routine inspection for radon contamination be conducted at the time of sale, just as termite inspections are now routine for resale homes in most areas of the country. A radon test at the time construction is completed, and at periodic intervals there-

(1979) (allowing a finding of fault only where the broker "knew or should have known that the representation might be false").

248. Traditionally, silence could not be fraud. Now, however, the Restatement provides: "A vendor of land who conceals or fails to disclose to his vendee any condition, whether natural or artificial, which involves unreasonable risk to persons on the land, is subject to liability to the vendee and others upon the land . . ." RESTATEMENT (SECOND) OF TORTS § 353(1) (1965).

249. See *Easton v. Strassburger*, 152 Cal. App. 3d 90, 102, 199 Cal. Rptr. 383, 390 (1984) (broker has duty to disclose facts which are known to him or accessible on reasonable investigation). See generally PROSSER & KEETON, *supra* note 135, § 106 (discussing duty of disclosures).

250. *Easton v. Strassburger*, 152 Cal. App. 3d 90, 102, 199 Cal. Rptr. 383, 390 (1984) (broker has duty to disclose facts which are known to him or accessible on reasonable investigation); *Reed v. King*, 145 Cal. App. 3d 261, 267, 193 Cal. Rptr. 130, 133 (1983).

251. See *Murray, The Real Estate Broker and the Buyer: Negligence and the Duty to Investigate*, 32 VILL. L. REV. 939 (1987).

252. High radon levels cannot be detected by visual inspections or otherwise be obvious to the buyer. A dangerous situation "cannot be detected except by special devices." *Berrebey, supra* note 33, § 3, at 6, col. 2.

253. Liability may exist where the seller of housing "knows or has reason to know of the condition, and realizes or should realize the risk involved." RESTATEMENT (SECOND) OF TORTS § 353(1)(b) (1965).

254. The National Association of Realtors now requires informing buyers "if the agent believes a home is in a radon-prone area." *Hanley, supra* note 4, at 39, col. 3.

255. There is even some precedent for requiring vendors of homes to inform purchasers of potential radiation hazards. See *Schnell v. Gustafson*, 638 P.2d 850, 852 (Colo. Ct. App. 1981) (failure to inform purchasers that home was located on top of uranium mill tailings may give rise to action for fraud).

after, could prevent or greatly mitigate health problems caused by radon contamination and avoid costly litigation.²⁵⁶

III. REMEDIES FOR RESIDENTIAL RADON CONTAMINATION

Establishing a standard of liability for high levels of indoor radon does not fully resolve the controversy. The measure of damages in these cases is by no means certain. The primary harm of indoor radon is its induction of lung cancer, which may be difficult to prove at common law. Plaintiffs undoubtedly will attempt to recover health-related damages for cancer, whether already sustained or merely anticipated. In addition, owners of radon-contaminated housing will seek to recover demonstrable property damages and the costs of correcting the conditions causing the high indoor concentrations. This section discusses the availability of these respective forms of damages.

A. *Health-Related Damages*

Damages to a homeowner's health should be recoverable under any of the liability theories discussed above.²⁵⁷ This section will address the ability of plaintiffs to recover damages associated with a future risk of radon-induced cancer. When cancer has actually resulted in radon-exposed family members, they may sue for actual damages such as medical expenses and pain and suffering; however, such a post facto action has significant practical limitations.²⁵⁸ The development of this cancer may have a twenty-year latency period,²⁵⁹ which necessarily would involve long delays in bringing suit. The long latency period presents significant problems for plaintiffs—by the time cancer occurs, defendants may be insolvent, critical evidence may be destroyed, proof of causation will be complicated, and the action may be time-barred by applicable statutes of limi-

256. In some places, such testing has already begun, through "radon inspection clauses" in real estate contracts. These clauses are already being criticized, however, "because they rely on radon tests that can be easily manipulated by sellers or affected by environmental conditions." Galen, *supra* note 3, at 10. If inspections and testing are misleading, of course the homeowners could have additional grounds for a cause of action in fraud.

257. There is some question whether health damages may be recovered under contract theories, such as implied warranty of habitability, but recent courts have chosen to grant such damages when appropriate. See, e.g., *Boudreau v. General Elec. Co.*, 2 Haw. App. 10, 625 P.2d 384 (1981).

258. See, e.g., Robinson, *Probabilistic Causation and Compensation for Tortious Risk*, 14 J. LEGAL STUD. 779, 787 (1985) ("[E]x post compensation may not be forthcoming in many cases of actual injury because of the special proof problems that are themselves generated by the long lag between act and injury . . ."). Post facto recovery for radon-induced cancer is by no means impossible, however. An employer has been held liable under a Colorado statute for exposing a worker to 0.15 working level months (WLM) of radon during an eight-day period. *Union Carbide Corp. v. Industrial Comm'n*, 196 Colo. 56, 58, 581 P.2d 734, 735 (1978). The Colorado Supreme Court held that this exposure represented "a concentration of toxic material which would be sufficient to cause the disease." *Id.* at 61, 581 P.2d at 737. This "sufficient cause" standard is specific to the Colorado occupational disease act, but if employed more generally, the rule would permit recovery for most individuals exposed to high indoor radon levels. See also *Gradel v. Inouye*, 491 Pa. 534, 544-45, 421 A.2d 674, 679 (1980) (applying this substantial factor in common-law negligence action for malpractice).

259. See, e.g., I. TURIEL, *supra* note 16, at 38 ("[t]here is an average latency period of approximately twenty years between exposure to radon and the onset of cancer"); Hanley, *supra* note 4, at 39, col. 1 (radon "can possibly cause lung cancer after latency periods of 20 to 30 years").

tations.²⁶⁰ Given these difficulties, plaintiffs have sought and likely will continue to seek to recover in anticipation of future cancer. The ability to recover for increased risk of contracting cancer, for fear of contracting cancer, and for costs of future medical surveillance will now be considered.

1. Pure Increased Risk Of Cancer

Under traditional principles of tort law, the mere risk of future harm is noncompensable. Dean Prosser has declared that "the threat of future harm, not yet realized, is not enough."²⁶¹ Numerous courts confronted with such claims have reaffirmed the traditional rule and held that simple risk of future cancer, unaccompanied by other injuries, is insufficient to sustain an award of damages.²⁶² In so holding, courts have emphasized that "[a]llowing recovery of risk of cancer damages not only encourages anticipatory lawsuits but runs counter to the desirable goal that cases be decided on the best quality evidence available."²⁶³ The courts have feared that "[t]o permit recovery for possible risk of injury or sickness raises the spectre of potential claims arising out of tortious conduct increasing in boundless proportion."²⁶⁴ Given the widespread nature of residential radon contamination, this fear of burgeoning litigation may be a particularly realistic one.

Notwithstanding these concerns, there is growing support for granting damages for future risk of cancer. Commentators recently have urged this view

260. See *Ayers v. Township of Jackson*, 106 N.J. 557, 525 A.2d 287 (1987). See generally SUPERFUND SECTION 301(E) STUDY GROUP, 97TH CONG., 2D SESS., INJURIES AND DAMAGES FROM HAZARDOUS WASTE—ANALYSIS AND IMPROVEMENT OF LEGAL REMEDIES (Part 1), 40-117 (Comm. Print 1982) (discussing "legal remedies for injuries and damage caused by exposure to hazardous waste"). One commentator has thus noted:

First, the cancer may not show itself for up to forty years after the exposure, long after evidence of the defendant's negligence has been lost or destroyed. Particularly troublesome would be proving the dose of the carcinogen to which the plaintiff was exposed and proving the identity of the defendant who actually exposed the plaintiff. Of increasing significance is the potential insolvency or disappearance of the defendant.

Note, *Damages for an Increased Risk of Developing Cancer Caused by Asbestos Exposure Are Only Recoverable If It Is More likely Than Not That Cancer Will Develop*, 51 MO. L. REV. 847, 857-58 (1986). Statutes of limitations may still present an insurmountable obstacle for some plaintiffs. See Farber, *Toxic Causation*, 71 MINN. L. REV. 1219, 1225 (1987).

261. PROSSER & KEETON, *supra* note 135, § 30.

262. See, e.g., *Plummer v. Abbott Laboratories*, 568 F. Supp. 920, 922 (D.R.I. 1983) ("the possibility that an individual may, because of the ingestion of certain drugs, have acquired a greater risk of contracting cancer does not per se constitute injury for purposes of tort law"); *Laswell v. Brown*, 524 F. Supp. 847, 850 (W.D. Mo. 1981) ("lawsuit for personal injuries cannot be based upon the possibility of some future harm"), *aff'd*, 683 F.2d 261 (8th Cir. 1982), *cert. denied*, 459 U.S. 1210 (1983); *Mink v. Univ. of Chicago*, 460 F. Supp. 713, 719 (N.D. Ill. 1978) ("mere fact of risk without any accompanying physical injury is insufficient to state a claim for strict products liability"); *Morrissey v. Eli Lilly & Co.*, 76 Ill. App. 3d 753, 761, 394 N.E.2d 1369, 1376 (1979) ("the possibility of developing cancer or other injurious conditions in the future is an insufficient basis upon which to recognize a present injury"); *Ayers v. Township of Jackson*, 189 N.J. Super. 561, 568, 461 A.2d 184, 187 (Law Div. 1983) ("enhancement of risk is not actionable"), *aff'd*, 202 N.J. 106, 493 A.2d 1314 (App. Div. 1985), *aff'd in part, rev'd in part*, 106 N.J. 557, 525 A.2d 287 (1987).

263. *Eagle-Picher Indus. v. Cox*, 481 So. 2d 517, 523 (Fla. Dist. Ct. App. 1985).

264. *Ayers v. Township of Jackson*, 189 N.J. Super. 561, 568, 461 A.2d 184, 187 (Law Div. 1983), *aff'd*, 202 N.J. 106, 493 A.2d 1314 (App. Div. 1985), *aff'd in part, rev'd in part*, 106 N.J. 557, 525 A.2d 287 (1987).

on the courts.²⁶⁵ In an important and recent decision involving a hazardous waste disposal site, *Sterling v. Velsicol Chemical Corp.*,²⁶⁶ the district court seemingly adopted a new, more liberal, rule permitting recovery for pure future risk of cancer. The court in *Velsicol* held that "enhanced susceptibility is an existing condition, and not a speculative future injury."²⁶⁷ Disclaiming the need for plaintiffs to prove any present injury,²⁶⁸ *Velsicol* held that "enhanced risk of liver and kidney disease and cancer suffered by the five flagship plaintiffs fits squarely within the rule articulated in those decisions, and plaintiffs are entitled to be compensated."²⁶⁹ Other recent decisions have implied that pure increased risk of cancer, if proved, may be sufficient to sustain a damage award.²⁷⁰ Persuasive individual judicial opinions may also foretell an increased willingness to permit recovery for pure increased risk of future cancer. Justice Handler of the New Jersey Supreme Court has argued in a concurring opinion that a plaintiff should be permitted to recover for roughly a twenty-five percent increase in cancer probability.²⁷¹ Justice Neely of the West Virginia Supreme Court likewise contended that recovery for future cancer risk should be available.²⁷² Judge Posner also has put forth a lengthy argument for the use of probabilistic mortality tables in measuring damages.²⁷³

Thus, in future cases the pure risk of increased future cancer from residential radon exposures, contrary to the long held common-law view, may be deemed compensable in some jurisdictions. Even assuming this development in the law of remedies the plaintiff will still bear the burden of proving a relatively high probability of actually developing future cancer. Initially, the homeowner must quantify the magnitude of his risk of cancer.²⁷⁴ Presumably, the well-established risk assessments for radiation would suffice as one method of demonstrating the magnitude of risk in radon exposure cases.²⁷⁵ But the mere fact that

265. See Gale & Goyer, *Recovery for Cancerphobia and Increased Risk of Cancer*, 15 CUMB. L. REV. 723 (1985); Note, *Increased Risk of Cancer as an Actionable Injury*, 18 GA. L. REV. 563 (1984).

266. 647 F. Supp. 303 (W.D. Tenn. 1986).

267. *Id.* at 322.

268. The court in *Velsicol* cited *Feist v. Sears Roebuck & Co.*, 267 Or. 402, 517 P.2d 675 (1973), in which "the [Oregon Supreme] Court rejected defendants' argument that 'the condition of being susceptible to a disease is not compensable as such, at least in the absence of any present harm caused by the possibility.'" *Velsicol*, 647 F. Supp. at 322. This language is dicta, however, inasmuch as the plaintiffs in *Velsicol* had all suffered present injury from defendants' negligence.

269. *Velsicol*, 647 F.2d at 322.

270. See Note, *supra* note 260, at 854 & n.100 (citing cases in which courts focused on the strength of plaintiffs' proof and implied that a showing of high enough probability of future damages would suffice to support damages for future risk).

271. *Evers v. Dollinger*, 95 N.J. 399, 422, 471 A.2d 405, 417 (1984) (Handler, J., concurring). Judge Handler stressed that recovery should be available for future risk of cancer, even "unquantified," arguing that "[f]ailure to do otherwise is grossly unfair." *Id.* at 429, 471 A.2d at 421.

272. *Jordan v. Bero*, 158 W. Va. 28, 210 S.E.2d 618 (1974) (Neely, J., concurring).

273. See *DePass v. United States*, 721 F.2d 203, 206 (7th Cir. 1983) (Posner, J., dissenting).

274. See *Ayers v. Township of Jackson*, 202 N.J. Super. 106, 122, 493 A.2d 1314, 1323 (App. Div. 1985) ("Faced with the admitted inability of the expert witness to quantify the increased risk, we cannot rule out the probability that such increase is so microscopically small as to be meaningless."), *aff'd in part, rev'd in part*, 106 N.J. 557, 525 A.2d 287 (1987).

275. A less-established procedure, extrapolation from animal tests, was accepted as adequate by the court in *Velsicol*, which held that "the use of animals is a valid and scientific basis to identify

a plaintiff may be able to quantify his increased risk of cancer will not ensure recovery. Courts that have implied a willingness to consider damages for pure future risk of cancer usually have required a showing of greater than fifty percent probability of suffering future cancer before they will grant relief.²⁷⁶ To meet this standard under the existing risk assessments, a plaintiff would have to demonstrate cumulative exposure to 5000 WLM of radon. Such exposure levels would be unusual, even in very high radon houses. Thus, under existing practice the vast majority of radon plaintiffs, though suffering significant exposure, would be foreclosed from recovery for increased future cancer risk. Unless judges begin to permit relief for future cancer probabilities of less than fifty percent,²⁷⁷ the pure risk of future cancer is unlikely to be available to plaintiffs exposed to indoor radon, even at levels well in excess of the current federal standards.²⁷⁸

2. Risk of Future Cancer Plus Present Harm

Courts are much more willing to grant damages for risk of future cancer when a plaintiff can demonstrate some existing harm from defendants' actions. This willingness is an inevitable consequence of the general doctrine against "claim-splitting." Under this doctrine, a party suing for present damages is precluded from bringing a second future action for subsequently realized damages resulting from the same episode. A plaintiff suing for present damages is not merely permitted, but required, to include claims for future risks.²⁷⁹

As a result, any plaintiff who can demonstrate some present harm is thereby able to attach a claim for damages from future increased cancer risk. In the case

potential human carcinogens and to attempt to quantify such a risk." *Velsicol*, 647 F. Supp. at 480; see also *Allen v. U.S.*, 588 F. Supp. 247, 425-28 (D. Utah 1984) (relying on the radiation dose risk models in assigning causation for cancer).

276. See *Hagerty v. L & L Marine Servs.*, 788 F.2d 315, 319 (5th Cir. 1986) ("plaintiff can recover only where he can show that the toxic exposure more probably than not will lead to cancer"); *Herber v. Johns-Manville Corp.*, 785 F.2d 79, 81 (3d Cir. 1986) (plaintiff must show "that he will more likely than not experience cancer in the future"); *Jackson v. Johns-Manville Sales Corp.*, 781 F.2d 394, 413 (5th Cir.) (en banc) (plaintiff may recover where evidence "indicates that he has a greater than fifty percent chance of getting cancer"), *cert denied*, 106 S. Ct. 3339 (1986); *Stites v. Sundstrand Heat Transfer, Inc.*, 660 F. Supp. 1516, 1523 (W.D. Mich. 1987) (requiring "reasonable certainty that the future consequences will occur"); *Martin v. Pacific Gas & Elec. Co.*, 203 Cal. 291, 264 P. 246 (1928) (reasonable certainty standard); *Pierce v. Johns-Manville Sales Corp.*, 296 Md. 656, 666, 464 A.2d 1020, 1026 (1983) (requiring "a greater than 50% chance that a future consequence will occur"); *Coffman v. McFadden*, 68 Wash. 2d 954, 961, 416 P.2d 99, 103 (1966) (plaintiff failed to "meet the test of reasonable probability that such conditions will occur").

277. In *Velsicol* the court granted damages for future risk of cancer based on the finding that "the increased risk is substantial and at least 25% to 30%." *Velsicol*, 647 F. Supp. at 480. This decision may foreshadow a more liberal test in future cases.

278. The distinction between regulatable and compensable risk was addressed in *Stites v. Sundstrand Heat Transfer, Inc.*, 660 F. Supp. 1516, 1525 (W.D. Mich. 1987), in which the court observed that although a risk in excess of 186 in 100,000 "may be unacceptable in a regulatory setting, it does not demonstrate a reasonable certainty that the affected plaintiff will get cancer." See also *In re "Agent Orange" Products Liab. Litig.*, 597 F. Supp. 740, 781 (E.D.N.Y. 1984) (for compensation of injuries at common law "a far higher probability (greater than 50%) is required"), *aff'd*, 818 F.2d 145 (2d Cir. 1987).

279. See, e.g., *Jackson v. Johns-Manville Sales Corp.*, 781 F.2d 394, 410-11 (5th Cir.), *cert. denied*, 106 S. Ct. 3339 (1986); *Gideon v. Johns-Manville Sales Corp.*, 761 F.2d 1129, 1137 (5th Cir. 1985) (party must join claim for future pulmonary disease in present case seeking damages for asbestosis).

of radon, however, there typically is no clear present harm (such as immediate disease) on which to attach the future cancer claim. Creative plaintiffs have established an avenue for surmounting this obstacle. In the first significant decision on indoor radon exposure, *Brafford v. Susquehanna Corp.*,²⁸⁰ plaintiffs alleged "immediate, present damage to their cellular and subcellular structures."²⁸¹ This alleged damage took the form of alterations in subcellular chromosomes, which is the initial precursor of what ultimately may become cancer. Defendants objected that this alleged harm had no external manifestation and was inadequate to meet the requirement of present damage.²⁸² The district court, however, observed that "experts are able to conclude with a reasonable degree of medical probability" that chromosome damage has resulted²⁸³ and that this chromosome damage is of sufficient magnitude to constitute a present harm permitting plaintiffs to recover for additional risk of future injury.²⁸⁴ *Brafford* is supported by analogous cases holding that the growth of a tumor due to medical inaction represents a present physical injury.²⁸⁵ Simple exposure to radon, absent demonstrable evidence of physical damage, may not suffice to constitute a present, actionable injury.²⁸⁶

Permitting a subcellular change to meet the present injury requirement opens a huge loophole in the rule. The "no-threshold" hypothesis suggests that any exposure to a carcinogen may cause subcellular injury, and a federal district court has observed that "the overwhelming weight of currently available scientific evidence supports the view that at *any* exposure level, ionizing radiation causes *some* degree of biological damage."²⁸⁷ Consequently, this exception could totally swallow the present injury rule in cancer cases. *Brafford* rejected this "slippery slope" argument.²⁸⁸ Similar subcellular damage has been recognized as a physical injury in cases involving mental distress for future risk of

280. 586 F. Supp. 14 (D. Colo. 1984).

281. *Id.* at 17.

282. Specifically, the defendant contended that "the changes are themselves nothing more than a subcellular expression of the increased risk." *Id.*; see *Laswell v. Brown*, 683 F.2d 261, 269 (8th Cir. 1982) (holding that the "risk of disease and cellular damage" represents only the "possibility of some future harm," not a present injury), *cert. denied*, 459 U.S. 1210 (1983).

283. *Brafford*, 586 F. Supp. at 17-18.

284. Citing plaintiffs' experts, the court observed that the subcellular damage might "deprive plaintiffs of a degree of immunity" and that the "'trigger' of a cancer change has been cocked." *Id.* at 18.

285. See *Evers v. Dollinger*, 95 N.J. 399, 408, 471 A.2d 405, 410 (1984) (holding that "the spread of cancer cells into once healthy tissue . . . is an injury in and of itself"); *Cloys v. Turbin*, 608 S.W.2d 697, 701 (Tex. Civ. App. 1980) (holding that even "imperceptible" growth of tumor constituted present injury).

286. See *Jackson v. Johns-Manville Sales Corp.*, 781 F.2d 394, 412 (5th Cir.) ("In a sense, the injury in this case is the inhalation of asbestos fibers. It was not an *actionable* injury, however, meaning it was not legally cognizable, until at least one evil effect of the inhalation became manifest."), *cert. denied*, 106 S. Ct. 3339 (1986); *Schweitzer v. Consolidated Rail Corp.*, 758 F.2d 936, 942 (3d Cir.) ("subclinical injury resulting from exposure to asbestos is insufficient to constitute the actual loss or damage . . . required to sustain a cause of action"), *cert. denied*, 474 U.S. 864 (1985).

287. *Allen v. United States*, 588 F. Supp. 247, 419 (D. Utah 1984).

288. *Brafford*, 586 F. Supp. at 17. The court noted that plaintiffs were exposed to high levels of radiation and thus experts were able to conclude with a reasonable degree of medical probability that chromosomal damage had occurred. *Id.* The court suggested no principled basis, however, for limiting the holding to any given degree of exposure to a carcinogen.

cancer.²⁸⁹

If *Brafford's* holding that subcellular damage is a present injury is sustained, most plaintiffs in indoor radon cases should be able to demonstrate such damage and therefore be able to sue for future cancer risk.²⁹⁰ In addition, plaintiffs' burden of proof in the "risk plus present damage" cases is somewhat less than in the "pure risk" cases. Unlike the latter cases, plaintiffs may not be required to demonstrate a greater than fifty percent probability of future cancer in order to recover.

The actual probability of future cancer risk that plaintiffs must prove is somewhat unclear. Even where a plaintiff has suffered a pre-existing harm, courts have occasionally limited recovery to instances when "the prospective consequences may, in reasonable probability be expected to flow from the past harm."²⁹¹ This reasonable probability standard may require evidence "sufficient to generate a belief that the tendered hypothesis is in all human likelihood the fact."²⁹² Alternatively expressed, plaintiffs have been allowed to recover for future risks that "reasonably are to be expected to follow, so far as human knowledge can foretell."²⁹³ While not stated in quantitative probabilistic terms, these standards suggest that a plaintiff still must demonstrate a fifty percent probability of future cancer before recovering for this risk, even when accompanied by actual present harm.²⁹⁴ Other cases have been more explicit in requiring a plaintiff prove a fifty percent or more probability of future cancer before permitting recovery.²⁹⁵

289. See *infra* note 308 and accompanying text. One plaintiff's attorney has suggested that "[a]s the development of medical science makes chromosomal damage as readily visible as broken legs, this perception [of noninjury] should diminish." Kanner, *Emerging Conceptions of Latent Personal Injuries in Toxic Tort Litigation*, 18 *RUTGERS L.J.* 343, 352 (1987).

290. In addition to the generalized presumption that any level of radiation exposure may be harmful, specialized medical techniques are available that may be able to detect chromosomal damage in the cells of potential plaintiffs. See Comment, *Damages in Genetic Mutation and Chromosomal Breakage: Tort Actions*, 26 *ST. LOUIS U.L.J.* 105, 107 n.13 (1981); Note, *Increased Risk of Disease From Hazardous Waste: A Proposal for Judicial Relief*, 60 *WASH. L. REV.* 635, 641-42 (1985).

291. *Herber v. Johns Manville Corp.*, 785 F.2d 79, 81 (3d Cir. 1986). See also *Morrissy v. Eli Lilly & Co.*, 76 Ill. App. 3d 753, 761, 394 N.E.2d 1369, 1376 (1979) ("possible future damages in a personal injury action are not compensable unless reasonably certain to occur"); *Bennett v. Mallinckrodt, Inc.*, 698 S.W.2d 854, 866 (Mo. Ct. App. 1985) (plaintiffs exposed to radiation must show future cancer is "reasonably certain to occur"), *cert. denied*, 106 S. Ct. 2903 (1986); *Hahn v. McDowell*, 349 S.W.2d 479, 482 (Mo. Ct. App. 1961) (auto accident victim must show future cancer was "reasonably certain to ensue" before being permitted to introduce evidence for future cancer risk); *City of Waco v. Teague*, 168 S.W.2d 521, 526 (Tex. Civ. App. 1943) ("plaintiff's recovery for future results of the injury was restricted to such as would reasonably and probably result"); *Coffman v. McFadden*, 68 Wash. 2d 954, 961, 416 P.2d 99, 103 (1966) ("test of reasonable probability that such conditions will occur as a result of the accident").

292. *Ayers v. Township of Jackson*, 189 N.J. Super. 561, 461 A.2d 184, 187 (Law Div. 1983), *aff'd*, 202 N.J. Super. 106 (1985 App. Div.), *aff'd in part, rev'd in part*, 106 N.J. 557, 525 A.2d 287 (1987).

293. *Anderson v. W.R. Grace & Co.*, 628 F. Supp. 1219, 1230 (D. Mass. 1986).

294. *Cf. Jackson v. Johns-Manville Sales Corp.*, 781 F.2d 394, 413 (5th Cir.) (court held that plaintiff permitted to recover for future risk because "evidence adduced at trial indicates that he has a greater than 50% chance of getting cancer"), *cert. denied*, 106 S. Ct. 3339 (1986).

295. See *Dawsey v. Olin Corp.*, 782 F.2d 1254, 1263 (5th Cir. 1986); *Johnson v. Armstrong Cork Co.*, 645 F. Supp. 764, 769 (W.D. La. 1986).

Conversely, however, a fairly substantial number of cases have held that plaintiffs may sometimes recover for a less than fifty percent risk of future damage. Courts have permitted some recovery for lesser probabilities in cases involving the occurrence of epilepsy as a result of collision,²⁹⁶ paralysis from bullet wound,²⁹⁷ cancer from medical malpractice,²⁹⁸ cancer from burns in an accident,²⁹⁹ and cancer from hazardous waste sites.³⁰⁰ While these holdings are still a minority, strong policy reasons are advanced for permitting recovery for less than fifty percent future risks.³⁰¹ Indeed, given the rule against claim-splitting, failure to compensate could totally preclude damages for a large number of plaintiffs who may go on to suffer cancer or other serious injuries. This issue was addressed in some detail in *Feist v. Sears, Roebuck & Co.*³⁰² In *Feist*, a child struck on the head by a falling cash register sought to introduce evidence of possible future meningitis resulting from a skull fracture.³⁰³ The court permitted this evidence, "even though meningitis was not probable, but was no more than a possibility."³⁰⁴

The typical risk from high indoor radon levels may be in the vicinity of only one percent; but where plaintiffs present evidence of a present injury from chromosomal damage, they may be able to recover for even this slight risk of future cancer.³⁰⁵ In more restrictive jurisdictions, where a fifty percent probability of

296. See *McCall v. United States*, 206 F. Supp. 421, 426 (E.D. Va. 1962) (three to twenty-five percent chance of future epilepsy resulting from trailer accident); *Potter v. Empress Theatre*, 91 Cal. App. 2d 4, 204 P.2d 120 (1949) (recovery for good possibility of future epilepsy); *Schwegel v. Goldberg*, 209 Pa. Super. 280, 228 A.2d 405 (1967) (five percent chance of future epilepsy resulting from car accident).

297. See *Martin v. City of New Orleans*, 678 F.2d 1321 (5th Cir. 1982), cert. denied, 459 U.S. 1203 (1983). The Fifth Circuit noted that "[w]hile the doctors did state that Martin's prognosis was good, they also testified that there would always be some risk of future complications." *Id.* at 1327. Although this risk was not quantified, the court permitted recovery for future risk, as well as mental distress. *Id.*

298. See *James v. United States*, 483 F. Supp. 581 (N.D. Cal. 1980) (even unquantifiable decrease in survival probability may be basis for some recovery); *Gradel v. Inouye*, 491 Pa. 534, 546, 421 A.2d 674, 680 (1980) ("a doctor properly may be allowed to explain the possible future effects of an injury, and with less definiteness than is required of opinion testimony on causation" permitting "the jury to consider the possibility of future metastasis in awarding damages"); cf. *James v. United States*, 483 F. Supp. 581 (N.D. Cal. 1980) (post facto recovery for 35% probability of causation); *Herskovits v. Group Health Co-op.*, 99 Wash. 2d 609, 664 P.2d 474 (1983) (post facto recovery for 14% decrease in lung cancer survival due to misdiagnosis).

299. See *Duncan v. Smith*, 376 S.W.2d 877 (Tex. Civ. App. 1964), rev'd, 393 S.W.2d 798 (Tex. 1965).

300. See *Sterling v. Velsicol Chem. Corp.*, 647 F. Supp. 303 (W.D. Tenn. 1986); *Village of Wilsonville v. SCA Servs., Inc.*, 86 Ill. 2d 1, 426 N.E.2d 824 (1981) (severe harm justifies compensation for relatively low probability risk).

301. See, e.g., *Gale & Goyer*, *supra* note 265, at 742-43 (noting that failure to compensate for such lesser risks may distort the deterrent and compensatory objectives of tort law).

302. 267 Or. 402, 517 P.2d 675 (1973). See also *Davis v. Graviss*, 672 S.W.2d 928, 931-32 (Ky. 1984) (plaintiff may recover for future spinal meningitis even if expert witness testifies only that plaintiff might possibly suffer this complication).

303. See *Feist*, 267 Or. at 403-05, 517 P.2d at 675-76.

304. *Id.* at 410, 517 P.2d at 679. Although this decision was only related to evidence admissibility, it carries the inevitable implication that "possible future effects" are entitled to consideration as "a matter of substantive law." *Id.* at 409-10, 517 P.2d at 678.

305. In this case the recovery should be one percent of the best estimate of the future expenses, pain, and suffering should the cancer actually occur.

future cancer is required, prospects for recovery from indoor radon contamination appear slim.

3. Fear of Future Cancer

Courts have been somewhat more willing to grant damages for a present fear of future cancer than for the risk of that cancer actually occurring. Decisions are increasingly willing to acknowledge the significance of mental anguish and suffering as compensable injuries, and "cancerphobia" is now a recognized emotional injury.³⁰⁶ A plaintiff who genuinely suffers from a serious present fear of incurring cancer from a defendant's activities often will be able to recover damages for such fear.

Plaintiffs must overcome several hurdles before obtaining recovery for cancerphobia. Many jurisdictions still require evidence of a physical injury or impact before allowing such emotional distress damages.³⁰⁷ In many cancer cases, this physical impact requirement has been relatively easy to satisfy. Some courts have recognized subcellular chromosomal damage as sufficient to establish physical injury.³⁰⁸ In other cases, the mere "ingestion" of toxic substances has been deemed sufficient physical impact or injury to support a mental distress claim.³⁰⁹ Under this liberal standard of physical injury the intrusion of radon daughters into the lungs of housing residents should be sufficient to maintain an

306. See, e.g., *Gale & Goyer*, *supra* note 265, at 724-36; see generally Holden, *Love Canal Residents Under Stress*, 208 SCIENCE 1242 (1980) (discussing psychological damage to citizens living near a chemical dump site).

307. One review indicated that "courts have been reluctant to compensate alleged mental injuries unless the plaintiff can establish the existence of a contemporaneous physical injury or impact." Edwards & Ringleb, *Exposure to Hazardous Substances and the Mental Distress Tort: Trends, Applications and a Proposed Reform*, 11 COLUM. J. ENVTL. L. 119, 121 (1986). See, e.g., *Johnson v. Armstrong Cork Co.*, 645 F. Supp. 764, 769 (W.D. La. 1986) ("evidence of fear of contracting cancer is admissible when there is an actionable injury"); *Payton v. Abbott Labs*, 386 Mass. 540, 552-55, 437 N.E.2d 171, 178-80 (1982) (discussing policy reasons underlying such a requirement). Several jurisdictions have abolished this requirement. See, e.g., *Bennett v. Mallinckrodt, Inc.*, 698 S.W.2d 854, 866 (Mo. Ct. App. 1985) ("Plaintiffs no longer need to allege a contemporaneous physical injury to plead a tort action for emotional distress."). In addition, independent physical injury usually is not required for instances of intentionally inflicted emotional distress. See, e.g., *Jackson v. Johns-Manville Sales Corp.*, 781 F.2d 394, 414 (5th Cir.) (distinguishing the two lines of precedent), *cert. denied*, 106 S. Ct. 3339 (1986).

308. See *Anderson v. W.R. Grace & Co.*, 628 F. Supp. 1219, 1226-27 (D. Mass. 1986). While defendants in this case contended that such damage was insufficient to support the present injury requirement, the court disagreed. The court held that plaintiffs' harm need only be "manifested by objective symptomatology." *Id.* at 1227. A similar result was reached in another case, in which plaintiff alleged that exposure to asbestos caused "pleural thickening" of the lungs, which defendant characterized as an "insubstantial injury." *Herber v. Johns-Manville Corp.*, 785 F.2d 79, 85 (3d Cir. 1986). The court held that plaintiff need only show "slight impact and injury" in order to recover for emotional distress. *Id.*

309. See *Wetherill v. University of Chicago*, 565 F. Supp. 1553, 1560 (N.D. Ill. 1983) (exposure to diethylstilbestrol sufficient to support action for emotional distress damages); *Eagle-Picher Indus. v. Cox*, 481 So. 2d 517, 527 (Fla. Dist. Ct. App. 1986) (inhalation of asbestos fibers satisfies impact requirement); *Laxton v. Orkin Exterminating Co.*, 639 S.W.2d 431, 434 (Tenn. 1982) (ingestion of toxic substance represents technical physical injury sufficient to maintain action for mental suffering). But see *Ayers v. Township of Jackson*, 189 N.J. Super. 561, 570, 461 A.2d 184, 189 (Law Div. 1983) (mere ingestion insufficient to satisfy the "substantial bodily injury or sickness" required to bring cancerphobia action), *aff'd*, 202 N.J. Super. 106 (1985 App. Div.), *aff'd in part, rev'd in part*, 106 N.J. Super. 557, 525 A.2d 287 (1987). But cf. cases cited *supra* note 286 (holding ingestion of carcinogenic substances is not sufficient present injury to warrant recovery for risk of future cancer).

action for cancerphobia. In *Velsicol*, the court found that "[b]ecause those contaminants were of such a nature as to cause the reported symptoms and cellular damage, and adverse biological change, (however slight) the Court considers that this ingestion, inhalation or contact caused emotional distress."³¹⁰ At the present time, there appears to be a trend toward abolishing the physical injury requirement,³¹¹ but where it is still a prerequisite to recovery for emotional distress, plaintiffs suing for radon exposure should be able to demonstrate such injury or impact.³¹²

Plaintiffs seeking compensation for cancerphobia must also demonstrate that their apprehension or fear of future cancer is "reasonable" under the circumstances.³¹³ Where every physician consulted "assured appellant she did not have cancer and that there was no cause for concern," the fear of cancer may be found unreasonable.³¹⁴ This reasonability requirement, though, is a much easier test than the fifty percent probability rule for future risk of cancer. In *Wetherill v. University of Chicago*, the court stressed that cancerphobia "merely demands a reasonable fear, not a high degree of likelihood, that the feared contingency be likely to occur."³¹⁵ The "reasonable fear" standard is a relatively light one, as the court held that "fears of future injury can be reasonable even where the likelihood of such injury is relatively low."³¹⁶ Even relatively low statistical probabilities of future disease do not invalidate a claim for reasonable fear of the disease.³¹⁷ When fear of future cancer is genuine and serious, the actual

310. *Velsicol*, 647 F. Supp. at 320.

311. *St. Elizabeth Hosp. v. Garrard*, 730 S.W.2d 649, 652-54 (Tex. 1987) (discussing general trends in the law and abolishing Texas' prior requirement for physical injury); see also *Laxton v. Orkin Exterminating Co.*, 639 S.W.2d 431, 434 (Tenn. 1982) (recovery for mental distress from ingestion of toxic substance even without showing of accompanying physical injury).

312. In addition to the cases cited *supra* note 311, courts in states requiring physical injury "are very lenient in finding allegations [of physical harm] sufficient" to satisfy the "definite and objective physical injury" standard. *Parnell v. Booth Newspapers, Inc.*, 572 F. Supp. 909, 917 (W.D. Mich. 1983).

313. See, e.g., *Stites v. Sundstrand Heat Transfer, Inc.*, 660 F. Supp. 1516, 1526 (W.D. Mich. 1987) ("[t]o recover on their fear of cancer claim, plaintiffs must establish . . . that their emotional distress is not 'about a completely fictitious, vague, fanciful or imagined consequence, having no reasonable basis'"); *Winik v. Jewish Hosp.*, 31 N.Y.2d 936, 937, 293 N.E.2d 95, 95, 340 N.Y.S.2d 927, 927 (1972) (plaintiff must "demonstrate that her fear of contracting cancer was reasonable").

314. *Winik v. Jewish Hosp.*, 31 N.Y.2d 936, 937, 293 N.E.2d 95, 95, 340 N.Y.S.2d 927, 927 (1972); see also *Howard v. Mt. Sinai Hosp.*, 263 Wis. 2d 515, 217 N.W.2d 383, 385 (1974) (no damages where the fear of future cancer was "remote" and "out of proportion to the culpability of the tortfeasor").

315. 565 F. Supp. 1553, 1559 (N.D. Ill. 1983); see also *Shelton v. City of College Station*, 765 F.2d 456, 468 (5th Cir. 1985) (plaintiff need not establish probability of future asbestos-induced cancer in order to recover for cancerphobia), *cert. denied*, 106 S. Ct. 3276 (1986); *Kroger Co. v. Beck*, 176 Ind. App. 202, 375 N.E.2d 640 (1978) (recovery for mental distress does not depend on actual occurrence of feared effects).

316. *Wetherill*, 565 F. Supp. at 1559.

317. See, e.g., *Clark v. Taylor*, 710 F.2d 4, 14 (1st Cir. 1983) (ten percent chance of future cancer); *Heider v. Employers Mut. Liab. Ins.*, 231 So. 2d 438, 442 (La. Ct. App. 1970) (two to five percent chance of epilepsy); see also *Anderson v. Welding Testing Laboratory, Inc.*, 304 So. 2d 351, 353 (La. 1974) (future cancer improbable); *Murphy v. Penn Fruit Co.*, 274 Pa. Super. 427, 418 A.2d 480, 484 (1980) (jury permitted to consider fear of future cancer from stab wound even though fear of future cancer and heart disease unfounded). These holdings may be questioned in the future, though, insofar as they impose potentially significant liability on defendants for medically unfounded fears. See Bohrer, *Fear and Trembling in the Twentieth Century: Technological Risk, Uncertainty and Emotional Distress*, 1984 Wis. L. REV. 83 (1984).

probability of contracting the cancer is not a significant barrier to recovery for mental anguish; however, some plausible basis for the fear of future cancer is required.³¹⁸ Authoritative medical assurance of low risk also may limit damages for fear of suffering future cancer.³¹⁹ Plaintiffs may also be required to prove that their mental distress was foreseeable by defendants.³²⁰

Plaintiffs' ability to recover for mental distress from the prospect of future cancer caused by indoor radon may be more significantly limited by the particular theory of defendants' liability in a given case. Courts have long recognized an action for intentional infliction of emotional distress, but proof of the requisite intent may be difficult in residential radon exposure actions.³²¹ Courts also have been willing to grant emotional distress damages for negligent exposure to cancer-causing agents.³²² Under strict liability, however, there is little precedent for compensating mental distress such as fear of future cancer.³²³ The Restatement of Torts on strict liability limits recovery for "physical harm."³²⁴ At least one prominent opinion has apparently followed the Restatement in denying recovery for emotional distress in strict liability actions.³²⁵ Other cases, however, have suggested that emotional distress damages may be recovered in at least some strict liability actions.³²⁶ Nor is it clear whether plaintiffs may be able to recover emotional distress damages in contract cases.³²⁷ The ability of

318. See *Harper v. Illinois Cen. Gulf R.R.*, 808 F.2d 1139, 1142 (5th Cir. 1987) (no cancerphobia recovery "absent competent evidence of exposure to the [carcinogenic] chemicals"). The decision in *Harper* stressed, however, that "precision is not required" in making such exposure estimates. *Id.* at 1141.

319. See *Laxton v. Orkin Exterminating Co.*, 639 S.W.2d 431, 434 (Tenn. 1982) (holding that damages for mental distress "would be confined to the time between the discovery of ingestion and the negative medical diagnosis or other information that puts to rest the fear of injury").

320. See *Molien v. Kaiser Foundation Hosp.*, 27 Cal. 3d 916, 923, 616 P.2d 813, 816-17 (1980) (damages for mental anguish permitted when doctors negligently told defendant his wife had syphilis).

321. See, e.g., *Wisniewski v. Johns-Manville Corp.*, 812 F.2d 81, 86-87 (3d Cir. 1987) (plaintiff workers unable to prove that asbestos company intentionally caused harm or acted with deliberate disregard for outcome). When radon plaintiffs can prove fraud, however, see *supra* text accompanying notes 243-56, they may be able to make out a case for intentional infliction of emotional distress.

322. See, e.g., *Herber v. Johns-Manville Corp.*, 785 F.2d 79, 84 (3d Cir. 1986) (negligent exposure of worker to asbestos); *Eagle-Picher Indus. v. Cox*, 481 So. 2d at 517, 526 (Fla. Dist. Ct. App. 1986) (negligent exposure of worker to asbestos); *Laxton*, 639 S.W.2d at 434 (negligent contamination of household water supply with toxic chemical).

323. *Velsicol* is somewhat vague on this issue. The court there found defendants liable both in strict liability and negligence and granted damages for fear of cancer, but did not specify whether such damages were limited to the negligence claim. *Velsicol*, 647 F. Supp. at 321. The court unambiguously held that mental distress damages were available for the tort of nuisance. *Id.* at 321. Nuisance is now regarded as an intentional tort, but the low standard of intent in nuisance bears some resemblance to strict liability. See PROSSER AND KEETON, *supra* note 135, at 624-25. Mental distress damages from a nuisance also have been awarded. *Lunda v. Matthews*, 46 Or. App. 701, 613 P.2d 63, 68 (1980); *Branch v. Western Petroleum, Inc.*, 657 P.2d 267, 278 (Utah 1982).

324. RESTATEMENT (SECOND) OF TORTS § 402A (1965).

325. See *Woodill v. Parke Davis & Co.*, 8 Ill. App. 3d 349, 374 N.E.2d 683 (1978), *aff'd*, 79 Ill. 2d 26, 402 N.E.2d 194 (1980).

326. See *Wetherill*, 565 F. Supp. at 1561 (upholding mental anguish recovery in failure to warn strict liability cases); *In re Air Crash Disaster Near Chicago*, 18 Av. Cas. (CCH) 17,215, 17,218 (N.D. Ill. 1983) (distinguishing *Woodill* as involving emotional distress for damages to a third party).

327. See *Melson v. Woodruff*, 23 So. 2d 364, 366 (La. Ct. App. 1945) (couple entitled to recover for "disappointment" due to breach of contract for sale of home); *Rogowicz v. Taylor & Gray, Inc.*,

radon-exposed plaintiffs to recover for emotional distress, absent negligence or intentional action, is still unclear and may be expected to vary by jurisdiction.

4. Future Medical Surveillance

Residents exposed to radon and fearful of future cancer may be prompted to seek additional and continuing diagnostic tests. These individuals may seek compensation for the costs of future medical surveillance, allegedly made necessary by defendants' tortious action. In *Hagerty v. L & L Marine Services*, the court recognized that a plaintiff should be able to recover "the cost of those checkups" that are proper "to ensure early detection and treatment of a possibly cancerous condition."³²⁸ Other courts also have evinced a willingness to grant recovery for demonstrably necessary future medical surveillance.³²⁹

The threshold requirements for recovery of such potential future medical expenses are still unclear. *Hagerty* appears to authorize recovery for any future treatment that is "medically advisable."³³⁰ This "medical advisability" test was also employed in *Johnson v. Armstrong Cork Co.*³³¹ Other courts have been much stricter.

In the lower court decision in *Ayers v. Township of Jackson*, for example, the court required that the future cancer risk must, at a minimum, be quantified.³³² In addition, the lower court suggested that plaintiffs must demonstrate a "reasonable probability" of developing cancer before "imposing upon defendant the financial burden of lifetime medical surveillance."³³³ Another New Jersey case, *Herber v. Johns-Manville Corp.*, also adopted the "reasonable probability" test for future medical surveillance recovery.³³⁴ Yet another court has required that a plaintiff demonstrate with reasonable certainty that future medical care will be required under state law.³³⁵ The most recent and detailed discussion of the standard for recovering for costs of future medical surveillance came on appeal of *Ayers*³³⁶ before the New Jersey Supreme Court. Plaintiffs' experts in *Ayers* acknowledged that they "could not quantify the extent of the enhanced risk of cancer."³³⁷ Nevertheless, the court granted damages for future medical

498 S.W.2d 352, 355-56 (Tex. Civ. App. 1973) (person may recover for foreseeable severe mental anguish from contract breach but may not recover for less serious, unforeseeable distress).

328. 788 F.2d 315, 319 (5th Cir. 1986).

329. See *Herber v. Johns-Manville Corp.*, 785 F.2d 79, 90 (3d Cir. 1986); *Devlin v. Johns-Manville Corp.*, 202 N.J. Super. 556, 561-62, 494 A.2d 495, 500 (Law Div. 1985); *Askey v. Occidental Chem. Corp.*, 102 A.D.2d 130, 477 N.Y.S.2d 242 (1984).

330. 788 F.2d at 319.

331. 645 F. Supp. 764, 769 (W.D. La. 1986) (relying on *Hagerty*).

332. 202 N.J. Super. 106, 120, 493 A.2d 1314, 1323 (1985) *aff'd in part, rev'd in part*, 106 N.J. 557, 525 A.2d 287 (1987).

333. *Id.*

334. 785 F.2d 79, 83 (3d Cir. 1986). The court then confused the issue considerably by implying that a plaintiff need only prove "a greater than average risk of contracting cancer." *Id.* Greater than average is obviously a much easier test than requiring a 50% probability of future cancer.

335. *Hendrix v. Raybestos-Manhattan, Inc.*, 776 F.2d 1492, 1507 (11th Cir. 1985).

336. 106 N.J. 557, 525 A.2d 287 (1987).

337. *Id.* at 588, 525 A.2d at 303. In *Ayers*, there was inadequate information regarding the exposure levels and the interaction of the various carcinogens to which plaintiffs were exposed. *Id.*

surveillance, rejected the fifty percent probability test, and required merely that plaintiffs demonstrate that their risk was "medically significant."³³⁸ In context, this test appears roughly comparable to *Hagerty's* "medically advisable" test.³³⁹

Under the reasonable probability test, which suggests a fifty percent risk as a threshold for recovery, few radon plaintiffs could obtain their costs of future medical surveillance. However, the risk from indoor radon is high enough that future diagnostic expenses might be justified under a "medical advisability" test, such as that employed in *Hagerty* or *Ayers*. No proof of present physical injury is required to recover anticipated costs of future medical surveillance.³⁴⁰ Where such future medical expenses are deemed compensable, they may provide a source of substantial recovery for plaintiffs.³⁴¹

B. *Property-Related Damages*

While somewhat less lucrative than personal injury damages, a homeowner plaintiff exposed to high radon levels has a somewhat greater surety of recovering some level of property damages. To some, these damages may be more important than public health recoveries.³⁴² Such a resident may recover the reduced value of her home, or obtain the costs of correcting the high radon levels, or even be able to rescind the real estate sales contract. The availability of these remedies will depend on various factors, including the type of liability proved. While property damages are readily available under the implied warranty of habitability, negligence, and fraud causes of action, the ability to recover purely economic damages under strict liability is less clear. In some real estate cases, however, homeowners have been permitted to recover property damages under a strict liability theory.³⁴³

1. *Reduced Property Value*

The standard measure for damages to real estate is reduction in property value.³⁴⁴ In the case of radon, highly elevated levels may significantly reduce

338. *Id.* at 606, 525 A.2d at 312-13.

339. The court in *Ayers* did not detail the showing required for medical significance, but relied on the testimony of a diagnostic physician from Mount Sinai Hospital to the effect that "plaintiffs required a program of regular medical surveillance." *Id.* at 599, 525 A.2d at 309. In so doing, the court implied that such damages would be granted whenever doctors believed that future surveillance was advisable. *See id.*

340. *See Friends for All Children v. Lockheed Aircraft Corp.*, 746 F.2d 816, 825 (D.C. Cir. 1984); *Habitants Against Landfill Toxicants v. County of York*, 15 Env'tl. L. Rep. (Env'tl. L. Inst.) 20937 (Pa. Ct. C.P. York County May 20, 1985).

341. In *Ayers*, the lower court granted over \$8,000,000 in damages to 339 plaintiffs, or more than \$20,000 per plaintiff. 202 N.J. Super at 113, 493 A.2d at 1321.

342. *See Berreby*, *supra* note 33, at 6, col. 6 ("people aren't worried about their health—they're worried about their property values").

343. *See Pearl v. Allied Corp.*, 566 F. Supp. 400, 402 (E.D. Pa. 1983) (property damages possible under strict liability for installation of formaldehyde insulation); *Kriegler v. Eichler Homes, Inc.*, 269 Cal. App. 2d 224, 226, 74 Cal. Rptr. 749, 751-52 (1969); *State Stove Mfg. v. Hodges*, 189 So. 2d 113, 124-25 (Miss. 1966), *cert. denied*, 386 U.S. 912 (1967).

344. *See, e.g., Crocker v. Reed*, 420 So. 2d 285, 286 (Ala. Civ. App. 1982). According to the Alabama court:

The measure of damages in a suit for the breach of warranty of habitability is the difference

the value of a home.³⁴⁵ When a plaintiff can prove a loss in property value attributable to the defendant's liability, he should be able to recover these damages. An exception to this rule exists when repair or correction of the problem would be more efficient than granting reduced property value. In many instances, such repair will be the preferred remedy, regardless of relative cost.

2. Repair

When a resident is confronted with a serious public health risk from radon contamination, his primary concern may be correction of the problem. Such residents may very well be tempted to repair the problem themselves, and subsequently attempt to recover their costs. As a general rule, however, repair costs are only recoverable when they are less than the reduction in property value.³⁴⁶ Thus, the full measure of repair costs may not be recoverable in all cases.³⁴⁷

Fortunately, correcting the radon problem will often be relatively inexpensive,³⁴⁸ and repair costs often will be recoverable or reasonable, even if ultimately borne by the homeowner. On occasion, however, correcting a radon problem may involve substantial costs, rising into thousands of dollars.³⁴⁹ Defendants may seek to avoid liability for these costs, preferring a possibly lesser cost in terms of reduced property value. Plaintiffs, though, can be expected to seek the full costs of repair.

The general rule granting the lesser of reduced value and repair cost is not a rigid one.³⁵⁰ A court's generalized concern for public health and welfare should

in the reasonable market value of the house in its condition at the time it was purchased and the reasonable market value of the house as it would have been had the house been constructed substantially according to the contract or warranty.

Id.; see also *Westwood Dev. Co. v. Sponge*, 342 S.W.2d 623, 628 (Tex. Civ. App. 1961) ("It is well settled that ordinarily the measure of damages for permanent and irreparable injury to real estate, where its value has not been totally destroyed, is the difference between the actual cash or market value immediately preceding the injury and such value immediately thereafter.").

345. See, e.g., *Public Apathy Said Barrier to Control of Indoor Air Contamination by Radon Gas*, 17 Env't Rep. (BNA) 1793, 1794 (Feb. 20, 1987) ("About ninety percent of respondents said discovery of high radon levels would adversely affect the resale value of a home, and nearly two-thirds of these believed the price of a house would decrease by 30 percent or more as the result of such a discovery.").

346. The Department of Interior recently summarized common-law property damages as "the lesser of diminution of market value or the cost of restoration or replacement." 51 Fed. Reg. 27674, 27690 (1986). See, e.g., *Regal Constr. Co. v. West Lanham Hills Citizen's Assoc.*, 265 Md. 302, 305, 260 A.2d 82, 84 (1970) ("if cost of restoration is disproportionate to diminution in value, then damage will be measured by the difference in value"); *Chevron Oil Co. v. Snellgrove*, 253 Miss. 356, 359, 175 So. 2d 471, 474 (1965) (courts use "the difference in value . . . to the premises" for damages, unless "the property may be restored to its former condition at a cost less than the value determined by the diminution of the value of the land," in which case restoration cost is the measure of damages). See also *United States v. Miller*, 317 U.S. 369 (1943) (plaintiff in condemnation proceeding entitled to fair market value for his property).

347. Homeowners must be aware of the growing number of fly-by-night radon testing and repair companies. For example, one company "made this thing you attach to your toilet that was supposed to make the radon go away with every flush." Berreby, *supra* note 33, § 3, at 6, col. 2 (quoting Stanley J. Watras, construction engineer).

348. See *supra* notes 99 & 105.

349. See *supra* notes 106-07.

350. The United States Supreme Court, for example, has "refused to make a fetish even of market value, since that may not be the best measure of value in some cases." *United States v. Cors*, 337

provide reason for correcting serious radon exposures. Where a plaintiff has a "personal reason" for restoration, rather than reduced market value, courts are more willing to grant restoration costs as damages.³⁵¹ Characteristics of an individual's home should suffice to provide such a personal reason,³⁵² especially when health and safety are involved. Courts also are more likely to grant repair costs for actions in tort, as opposed to contract.³⁵³ When repair costs are vastly disproportionate to reduced market value, however, courts may hesitate to authorize such repair expense as damages.³⁵⁴ In most instances, however, repair costs should be available as a remedy for successful plaintiffs.

3. Rescission

Some homeowners who have been exposed to high radon levels may prefer moving to remaining in even a repaired home. These plaintiffs may seek to rescind the contract under which they purchased the radon-contaminated home. Where a successful case can be made for fraud, a plaintiff presumptively will be able to elect to rescind the contract and obtain some restitution for past payments on the house.³⁵⁵ Rescission also may be available for a violation of the implied warranty of habitability.³⁵⁶

In addition to fraud and implied warranty of habitability, discussed above, rescission may be available under the doctrine of mutual mistake. When the parties to a transaction are mistaken regarding a basic assumption of the contract, either may rescind upon discovery of the mistake.³⁵⁷ In the present con-

U.S. 325, 332 (1949). On another occasion, the Court stressed that market value "is not an absolute standard nor an exclusive method of valuation." *United States v. Virginia Elec. & Power Co.*, 365 U.S. 624, 633 (1961).

351. See, e.g., *United States v. Certain Land in Borough of Brooklyn*, 346 F.2d 690, 694 (2d Cir. 1965); *Malloof v. United States*, 242 F. Supp. 175, 183 (D. Md. 1965); *Levi v. Schwarz*, 201 Md. 575, 581, 95 A.2d 322, 327 (1953); *In re County of Suffolk*, 47 N.Y.2d 507, 511, 392 N.E.2d 1236, 1238, 419 N.Y.S.2d 52, 54 (1979).

352. See *Samson Constr. Co. v. Brusowankin*, 218 Md. 458, 469, 147 A.2d 430, 437 (1958) (quoting RESTATEMENT OF TORTS § 929, to the effect that if "a building such as a homestead is used for a purpose personal to the owner," then "damages ordinarily include an amount for repairs, even though this might be greater than the entire value of the building").

353. See *Board of Educ. v. Commonwealth*, 528 S.W.2d 657, 659 (Ky. Ct. App. 1975) ("cost of restoration or repair, where feasible, always has been the measure of damages in tort cases for damage to structures on realty").

354. See *Farny v. Bestfield Builders, Inc.*, 391 A.2d 212, 214 (Del. Super. Ct. 1978) (permitting consideration of restoration costs but rejecting this remedy when it is "unreasonable and unduly excessive for the amount of damage suffered").

355. See D. DOBBS, REMEDIES § 9.2 (1972); PROSSER & KEETON, *supra* note 135, § 105 at 729 ("when a contract, or other bargaining transaction, such as a conveyance of an interest in land, is induced by a material misrepresentation by one of the parties to the transaction, the other party who is adversely affected may rescind").

356. See, e.g., *Petersen v. Hubschman Constr. Co.* 27 Ill. 2d 31, 389 N.E.2d 1154 (1979) (permitting rescission for violation of implied warranty of habitability even where house was not dangerously unsafe); *Finke v. Woodard*, 122 Ill. App. 3d 911, 462 N.E.2d 13 (1984) (permitting rescission for violation of implied warranty of habitability where, among other problems, there was future risk of wall falling out of structure); *Snowden v. Gaynor*, 710 S.W.2d 481 (Mo. Ct. App. 1986) (permitting rescission for violation of implied warranty of habitability for cracks in home).

357. See RESTATEMENT (FIRST) OF CONTRACTS § 502 (1932). According to the Restatement: [W]here the parties on entering into a transaction that affects their contractual relations are both under a mistake regarding a fact assumed by them as the basis on which they entered

trover, when indoor radon levels are unknown, the parties were mistaken regarding the fundamental safety of the residence. Courts have granted rescission of real estate contracts for mistakes of lesser magnitude. For example, in *Miller v. Varilek*³⁵⁸ the purchase of a house with an inoperable septic system that rendered the property uninhabitable provided grounds for rescission under the doctrine of mutual mistake. Rescission for mistake has also been granted for inadequacy of water pressure³⁵⁹ and termite infestation.³⁶⁰ Placed in the context of these decisions, the unsafe nature of dwellings with high radon concentrations should be sufficient to qualify as a mutual mistake over a basic assumption.

The right of rescission due to mutual mistake is not absolute. Where a homeowner has assumed the risk of mistake, such as through an effective disclaimer of liability, rescission will be denied.³⁶¹ Mere negligence in inspection by the buyer, however, should not bar rescission.³⁶² Rescission for mutual mistake may also be unavailable where the defect can be easily and inexpensively corrected.³⁶³ Notwithstanding these defenses, mutual mistake holds some promise as a last resort for plaintiffs suing for radon contamination. To succeed in mistake, plaintiff need not show defendant's knowledge of the hazard, negligence, or even a "defect" under the standards of strict liability. By simply proving the existence of high levels of indoor radon, plaintiff may be deemed to show a mutual mistake over a vital fact in the transaction, and thereby avoid the contract. Under some circumstances, however, a plaintiff may elect either rescission and damages as her remedy, or an equitable action for rescission may preclude recovery of other contract damages.³⁶⁴

into the transaction, it is voidable by either party if enforcement of it would be materially more onerous to him than it would have been had the fact been as the parties believed it to be

Id. Rescission also may be available for unilateral mistake, when only the buyer is unaware of the radon problem. See *Cummings v. Dusenbury*, 129 Ill. App. 3d 338, 342-45, 472 N.E.2d 575, 578-79 (1984) (permitting rescission for unilateral mistake in real estate); *Bucciero v. Drinkwater*, 13 Mass. App. 551, 434 N.E.2d 1315 (1982). In this case, where the seller is aware of a radon problem, he or she should be under a duty to inform the buyer, and failure to do so would represent fraud as well as unilateral mistake.

358. 117 Mich. App. 165, 171, 323 N.W.2d 637, 639 (1982).

359. *Blythe v. Coney*, 228 Ark. 824, 827, 310 S.W.2d 485, 487 (1958).

360. *Davey v. Brownson*, 3 Wash. App. 820, 825-26, 478 P.2d 258, 260 (1970).

361. See RESTATEMENT (SECOND) OF CONTRACTS § 154 (1979) (providing that a "party bears the risk of mistake" when it is allocated to him "by agreement of the parties," or when "he is aware, at the time the contract is made, that he has only limited knowledge with respect to the facts to which the mistake relates but treats his limited knowledge as sufficient."); see, e.g., *Lenawee County Bd. of Health v. Messerly*, 417 Mich. 17, 28-29, 331 N.W.2d 203, 209 (1983).

362. See RESTATEMENT (SECOND) OF CONTRACTS § 157 (1979) (negligence does not bar rescission for mutual mistake).

363. See, e.g., *Grant v. Morris*, 2 Wash. App. 134, 498 P.2d 336 (1972) (where it would cost \$5000 to remedy construction defects in a \$525,000 apartment building).

364. See, e.g., *Owens v. Smith*, 154 So. 2d 878 (Fla. Dist. Ct. App. 1963) (suit in equity for rescission precludes recovery of damages for same fraud); *Sickels v. Aetna Sec. Co.*, 220 Ind. 347, 41 N.E.2d 947 (1942) (requiring election of damages between rescission and fraud); *Mills v. Keasler*, 395 S.W.2d 111 (Mo. 1965); *Turner v. Carey*, 227 S.C. 298, 87 S.E.2d 871 (1955). Analogously, a suit for damages may preclude an action for rescission. See *L'Evesque v. Rognrud*, 254 Minn. 55, 93 N.W.2d 672 (1958) (requiring election of remedies). Thus, a plaintiff could not both rescind the contract and receive reduced property value damages. In several more recent cases, however, courts have permitted plaintiffs to seek both rescission and damages when the two remedies would not involve duplicative recoveries. See *Walraven v. Martin*, 123 Mich. App. 342, 333 N.W.2d 569

CONCLUSION

A substantial number of American houses are presently exposing their occupants to a serious risk of cancer, far exceeding that from hazardous waste dumps or other general environmental problems. As citizens become increasingly aware of the radon hazards present within their own homes, they are certain to react. Such individuals no doubt will seek redress at law—including correction of the hazardous situation and the recovery of damages for exposure to high radon levels.

A homeowner's ability to establish liability in circumstances of excessive indoor radon contamination is currently unclear. The precise nature of the theories and types of recovery available is not defined any better. Notwithstanding this uncertainty, such individuals should succeed in most instances of high radon exposure. The magnitude of the radon risk is massive, easily dwarfing other better known environmental hazards. The continued presence of this risk is inexcusable, given the ease of correcting the vast majority of homes with excessive radon. Consequently, it is incumbent upon builders and other real estate professionals to correct the problem and assume responsibility for their past mistakes.

Such an expansion of liability is sure to be feared and resisted by the building industry. Anticipation of another asbestos situation, with widespread bankruptcy and the virtual destruction of a major industry, is a proper concern for policymakers and even courts.³⁶⁵ Yet important differences between the asbestos and radon situations suggest a more promising result of radon litigation. While the overall national harm from radon may equal or even surpass that of asbestos, the risk to any given individual is likely to be less. Accordingly, massive personal injury damage awards should be much less common for radon plaintiffs. The remedy for radon contamination will often be limited to the costs of home repair, future medical surveillance, and possibly some small percentage of future cancer costs. If so, the tort system will be operating at its best, serving to correct a major public health problem at reasonable cost to defendants. For those fewer individuals exposed to extraordinarily high levels, and extraordinarily high risks of cancer, more substantial compensation should be forthcoming.

(1983) (permitting plaintiff to pursue both rescission and consequential damages, but recovery cannot be had for both); *Kinkade v. Markus*, 38 Or. App. 131, 589 P.2d 1142 (1979) (permitting rescission and damages for improvements to property); *Isaacs v. Bokor*, 566 S.W.2d 532 (Tenn. 1978). Under these cases, a plaintiff should be able to obtain rescission and damages for interim improvements or health damages.

365. Approximately 20,000 asbestos cases are now pending, with cumulative claims in excess of \$30 billion. Johns-Manville, of course, has declared bankruptcy as a result of the threat of this litigation. See Rosenberg, Book Review, 99 HARV. L. REV. 1693 1698-1701 (1986) (reviewing P. BRODEUR, *OUTRAGEOUS MISCONDUCT: THE ASBESTOS INDUSTRY ON TRIAL* (1985)).

