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Indoor Air Quality Update

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Federal Radon Activities Inventory

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DOE/ER-0409

Federal Radon Activities Inventory

Committee on Indoor Air Quality
Radon Work Group

1988-1989

U.S. Department of Energy
Office of Energy Research

U.S. Environmental Protection Agency
Office of Radiation Programs

Washington, D.C. 20545

CIAQ

THE RADON WORKGROUP

This inventory of Federal Radon Activities was prepared by the Radon Workgroup of the Interagency Committee on Indoor Air Quality (CIAQ). The Radon Workgroup coordinates Federal programs related to radon. Membership is open to all Federal agencies and any interested persons are encouraged to participate.

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INTRODUCTION

In recent years, the concern over exposure to indoor radon has increased dramatically. Consequently, numerous Federal agencies have become involved in radon related activities. The Radon Workgroup of the Interagency Committee on Indoor Air Quality (CIAQ) perceived a need for coordination of these various projects and in response developed this inventory to serve as a consolidated resource document on Federal radon activities. It is hoped that this inventory will promote better communication among the involved agencies.

The Radon Workgroup member agencies have listed their current radon projects in the inventory. Each chapter of the inventory is devoted to one agency. Within the chapters, individual projects are listed under their appropriate office. To facilitate the use of this inventory as a resource document, an index has been included in which the projects are listed by key words.

DEPARTMENT OF COMMERCE

DEPARTMENT OF COMMERCE

DOC-101 NIST Radon Measurement Standards Program

* Type of Activity:	Applied research
* Primary Funding Agency:	National Institute for Standards and Technology
* Other Funding Agency:	None
* Funding for FY 88:	$200,000
* Status:	Ongoing
* Principal Contact:	Dr. R. Collé National Institute for Standards and Technology Bldg. 245, Room C229 Gaithersburg, MD 20899 (301) 975-5527
* Other Contact:	Dr. J.M.R. Hutchinson

* Activity Description:

1. Research objectives - The primary radon measurement system, which constitutes the national radon measurement standard, consists of pulse ionization chambers and ancillary gas-handling and -purification equipment. This system is currently undergoing a significant upgrading.

   In addition, NIST currently provides several transfer calibration standards and services, as well as a limited program to develop and disseminate new standards and services. These include: Ra-226 SRMs for primary radon calibrations; radon calibrations for other laboratories (directed primarily at other calibration laboratories like EPA and DOE which maintain an independent calibration capability); radon measurement intercomparisons with the principal U.S. radon labs (recently conducted); a prototype radon-in-water standard generator; a radon flux density standard which is under development; a new NaI(Tl) secondary measurement system which is used in conjunction with spherical glass ampoules containing radon samples; and a new international radon measurement intercomparison which is being planned for early 1989.

2. Relevance to radon issue - The upgraded system will replace the extant outdated system and allow NIST to continue to provide a national radon measurement standard into the 21st century.

NATIONAL INSTITUTE FOR STANDARDS & TECHNOLOGY

DOC-102 Energy Deposition and Radiation Quality of Radon and Radon Daughters
(Same as DOE-108)

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$38,000
* Status:	New
* Principal Contact:	R. S. Caswell National Institute for Standards and Technology Ionizing Radiation Division (536) Gaithersburg, Maryland 20899
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objective of this research is to create a quantitative microdosimetric description of the interaction of the alpha particles from radon and its daughters with the cells at risk in the lung and adjacent areas.

2. Relevance to radon issue - The present research is devoted to the development of mechanistic models of radiation induced lung cancer, better definition of the cells at risk in the respiratory tract, and the radiation interactions with them.

DEPARTMENT OF COMMERCE

DOC-103 Identification of Radon Potential at a Building Site
(Same as HUD-101)

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	HUD
* Other Funding Agency:	National Assoc. of Home Builders/NRC; State of New Jersey
* Funding for FY 88:	$40,000
* Status:	New
* Principal Contact:	Conrad Arnolts Department of Housing and Urban Development 451 7th Street, S.W. Room 8230 Washington, D.C. 20410 (202) 755-5528
* Other Contact:	

* Activity Description:

1. Research objectives - The objective of this research is to investigate techniques builders can use to identify whether a given building site will present a radon hazard. This will complement on-going DOE, EPA, and USGS area potential studies.

2. Relevance to radon issue - This information will help builders determine when to design and build mitigation measures in new housing.

DEPARTMENT OF DEFENSE

DEPARTMENT OF DEFENSE

DOD-101 U.S. Army Radon Reduction Program

* Type of Activity:	Operational program
* Primary Funding Agency:	Department of the Army
* Other Funding Agency:	None
* Funding for FY 88:	Paid for by individual Army installations
* Status:	New
* Principal Contact:	Emery C. Lazar Army Environmental Office Washington, D.C. (202) 272-8693
* Other Contact:	Walter Mikucki Army Corps of Engineers Construction Engineering Research Laboratory Champaign, Illinois (217) 373-7227

* Activity Description:

1. Research objectives - The U.S. Army Radon Reduction Program was established on March 21, 1988 with publication of a Headquarters Letter requiring that buildings owned and leased by the Army be tested for radon, and remedial actions be taken if the levels are higher than 4 picocuries per liters of air. About 900,000 detectors will be placed in approximately 350,000 buildings in the U.S. and overseas. The requirement for completion of remedial action ranges from one month to five years, depending on the level of radon detected. All radon testing must be completed by FY 91 and all abatement by FY 97.

2. Relevance to radon issue - This program will aid in the identification of buildings with elevated radon levels so that remedial actions may be taken to reduce exposure of the occupants to radon.

DEPARTMENT OF THE ARMY

DEPARTMENT OF DEFENSE

DOD-102 Navy Radon Assessment and Mitigation Program

* Type of Activity:	Operational Program
* Primary Funding Agency:	Department of the Navy
* Other Funding Agency:	None
* Funding for FY 88:	$500,000
* Status:	New

* Principal Contact:

Commander Karl Mendenhall
Chief of Naval Operations
OP-45
Washington, DC 20350-2000
(202) 692-5604/08

* Other Contact:

Mr. Michael F. Larson
Environmental Quality Division
Naval Facilities Engineering Command
200 Stovall Street
Alexandria, Virginia 22332-2300
(703) 325-8539

* Activity Description:

1. Research objectives - The objective of this assessment is to screen Navy and Marine Corps installations for structures with elevated radon levels and to reduce elevated levels, where found, to below 4 pCi/l. An initial screening phase will begin in January, 1989, and will sample housing, schools, day care centers, hospitals, brigs and transient living quarters Navy-wide. This will be followed by a detailed screening phase which will sample 100% of the occupied structures on installations found to have radon levels above 4 pCi/l in the initial screening. Radon mitigation will take place following EPA guidelines, and post-mitigation monitoring will be conducted.

2. Relevance to radon issue - This project will allow the Department of the Navy to assess radon levels in Navy and Marine Corps structures, and mitigate where elevated levels are found.

DEPARTMENT OF THE NAVY

DEPARTMENT OF DEFENSE

DOD-102 Navy Radon Assessment and Mitigation Program

* Type of Activity:	Operational Program
* Primary Funding Agency:	Department of the Navy
* Other Funding Agency:	None
* Funding for FY 88:	$500,000
* Status:	New

* Principal Contact:

Commander Karl Mendenhall
Chief of Naval Operations
OP-45
Washington, DC 20350-2000
(202) 692-5604/08

* Other Contact:

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2. Relevance to radon issue - This project will allow the Department of the Navy to assess radon levels in Navy and Marine Corps structures, and mitigate where elevated levels are found.

DEPARTMENT OF DEFENSE

DOD-103 Radon Assessment and Mitigation Program

* Type of Activity:	Operational Program
* Primary Funding Agency:	U.S. Air Force
* Other Funding Agency:	None
* Funding for FY 88:	$775,000
* Status:	Ongoing

* Principal Contact: Jayant B. Shah, USAF/LEEV
Environmental Policy Division
Bolling AFB
Washington, DC 20332
(202) 767-6245

Lt. Col. Edward Bishop USAF/SGPA
HQ USAF/SGPA
Bolling AFB
Washington, DC 20332
(202) 767-1735

* Other Contact: Don Weber
HQ USAF/LEEHT
Pentagon
Washington, DC
(202) 697-0157

* Activity Description:

1. Research objectives - The primary objectives of the Air Force radon program are to identify, evaluate and mitigate potential sources of radon which could pose unacceptable risks to the Air Force populace world-wide. The Air Force Radon Assessment and Mitigation program (RAMP) will be accomplished in three major phases: (1) Initial screen, (2) Detailed assessment, and (3) Radon mitigation. The RAMP is based on currently available U.S. EPA Radon program guidelines. The initial screen phase of Radon assessment was completed in March 1988. Detailed assessment is ongoing with some mitigation underway.

2. Relevance to radon issue - The project implements measures to reduce radon exposure to the Air Force populace.

U.S. AIR FORCE

DEPARTMENT OF ENERGY

OFFICE OF REMEDIAL ACTION AND WASTE TECHNOLOGY

DEPARTMENT OF ENERGY

DOE-101 Technical Measurements Center

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	DOE Office of Remedial Action and Waste Technology
* Other Funding Agency:	None
* Funding for FY 88:	$400,000
* Status:	Ongoing
* Principal Contact:	John R. Duray UNC Geotech FTS 322-9543
* Other Contact:	Tony Brazley U.S. Department of Energy (202) 353-5438 FTS 233-5438

* Activity Description:

1. Research objectives - This project aids DOE and its remedial action contractors in making reliable radon and radon-daughter measurements. Instruments and devices from radon measurement services are tested and evaluated in the DOE Grand Junction Projects Office environmental chambers. Additional testing in field studies is done to evaluate how well the annual average radon (or radon-daughter) concentration can be estimated. Field study results are the basis for developing improved measurement methods to be used by remedial action contractors. Periodic quality control exposures and calibrations are performed for all remedial action contractors.

2. Relevance to radon issue - This research will assist in the development of accurate and reliable radon measurements that are necessary to determine true exposure.

OFFICE OF ENVIRONMENTAL ANALYSIS

DEPARTMENT OF ENERGY

DOE-102 Radon Macromodel Concept Development

* Type of Activity:	Applied research
* Primary Funding Agency:	DOE Office of Environmental Analysis
* Other Funding Agency:	None
* Funding for FY 88:	$20,000
* Status:	New

* Principal Contact:

G. Traynor
Lawrence Berkeley Labs
Indoor Environmental Program
Building 90, Room 3058
Berkeley, California 94720

* Other Contact:

David Moses
U.S. Department of Energy
Office of Environmental Analysis
(202) 586-2061

* Activity Description:

1. Research objectives - A methodology will be developed for applying the combustion sources exposure model, which estimates residential indoor combustion pollutant concentration distribution in the U.S., to radon.

2. Relevance to radon issue - Should the radon macromodel be developed, it will provide a predictive tool for estimating national exposures.

OFFICE OF CONSERVATION ENERGY

DEPARTMENT OF ENERGY

DOE-103 Energy Conservation Impacts of Indoor Radon

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	DOE Office of Conservation Energy
* Other Funding Agency:	None
* Funding for FY 88:	$300,000
* Status:	Ongoing
* Principal Contact:	R. Sextro Lawrence Berkeley Labs Indoor Environmental Program Building 90, Room 3058 Berkeley, California 94720 (415) 486-6591
* Other Contact:	John Talbott U.S. Department of Energy (202) 586-9446

* Activity Description:

1. Research objectives - The overall objective of this research is to minimize or eliminate the adverse energy impacts associated with the Nation's radon mitigation activities. Past projects have included studies of radon entry and control in new and existing residential structures. Current and future work will include a study of the long term effectiveness of active mitigation systems, and the expansion of the project to include commercial buildings.

2. Relevance to radon issue - The interaction of the building with surrounding environment has been an important element of radon research. This project emphasizes this interaction through its long time association with buildings energy research. Consequently, fundamental concepts of the relationship of energy requirements and radon mitigation are provided by this project.

OFFICE OF ENERGY RESEARCH

DEPARTMENT OF ENERGY

DOE-104 A Hit-Size Effectiveness Function (HSEF) for Chromosome Aberrations

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$200,000
* Status:	New
* Principal Contact:	V. P. Bond Brookhaven National Laboratory Medical Department, Building 490 Upton, New York 11987
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - Relative biological effectiveness (RBE) values for high linear energy transfer (LET) radiations have not been obtained for human malignancies, nor can they be estimated satisfactorily by means of animal RBE studies. An alternative approach that may be useful for evaluating the risk from radiation fields of mixed LET (e.g., radon exposure) is the hit-size effectiveness function (HSEF), i.e., the cell dose vs. the probability of cell transformation. Therefore, it is proposed to obtain HSEFs using endpoints related to human cancer, e.g., chromosome aberrations, in human lymphocytes, of the type reported to be causally linked in human carcinogenesis. High-LET (neutron and heavy ion) exposures using human cell endpoints rather than expressed cancer, and microdosimetry, assure that the radiation energy-biology coupling is measured at the individual cell genome level.

2. Relevance to radon issues - A principal purpose and use of the HSEF is to permit ready evaluation of absolute risk, particularly in radiation fields of mixed quality including high-LET radiations.

DOE-105 Biological Effectiveness of Radon Alpha Particles: Microbeam Study of Dose Rate Effects

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$183,000
* Status:	New
* Principal Contact:	L.A. Braby Battelle Memorial Institute Pacific Northwest Laboratory P.O. Box 999 Richland, Washington 99352
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objective of the proposed study is to investigate the malignant transformation of mammalian cells exposed to single, and successive, alpha particles which pass through the cell nuclei. The precision of these measurements, which will maintain control of the alpha particle energy, the number, position, and time between individual particles, will provide sensitive tests of proposed mechanisms for the enhanced radiobiological effectiveness of alpha particles and other high LET radiation at extremely low dose and dose rates.

2. Relevance to radon issue - This effort is directed toward understanding the mechanisms of the effect of radiation and thus to provide the basis for reliable estimates of risk and of the interaction of radiation with other agents.

DEPARTMENT OF ENERGY

DOE-106 Lung Cancer Risk from Inhalation of Radon and Other Pollutants in Rats

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$175,000
* Status:	New
* Principal Contact:	Frederick J. Burns NYU Medical Center Institute of Environmental Medicine 550 First Avenue New York, New York 10016
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objective of this research is to produce data in experimental animals that will be helpful for assessing the carcinogenic risk of radon inhaled either alone or in combination with pollutants commonly found in the home environment. The proposed experiments will provide three important pieces of information relevant to risk assessment: (1) the relationship between the alpha particle dose and the incidence of DNA damage in the proliferating basal cells of the trachea, (2) the rate of proliferation of the tracheal basal cells, and (3) the cancer incidence associated with known alpha particle doses either with or without exposure to at least two common household pollutants.

2. Relevance to radon issue - The project will produce information that will be directly useful for evaluating the likely effects of chronic indoor pollutants on the risk of respiratory cancer by radon inhalation.

DOE-109 Molecular Mechanisms of Radiation-Induced Mutations in Human Cells

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$87,000
* Status:	New
* Principal Contact:	David J. Chen Los Alamos National Laboratory P.O. Box 1663 Los Alamos, New Mexico 87545
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The goal of this research is to study the mechanistic basis for gene mutation induced by ionizing-radiation in normal fibroblasts by: (1) molecular analysis of the kind of DNA damage at the human GHPRT locus by comparison of molecular patterns of the altered HGPRT gene and its mRNA after exposure of human cells to x-rays, a-particles, and heavy ions, (2) characterization of the size of the deletion induced by various types of radiation, (3) molecular identification of repairable and non-repairable mutational damage induced by ionizing radiation.

2. Relevance to radon issue - From this project a model system to analyze the types of mutation damage induced by radon exposure in human cells can be developed.

DEPARTMENT OF ENERGY

DOE-110 Dynamics of Radon Progeny Interactions with Indoor Aerosols

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$113,000
* Status:	New
* Principal Contact:	Yung-Sung Cheng Lovelace Biomedical and Environmental Research Institute P.O. Box 5890 Albuquerque, New Mexico 87185
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The goal of this project is to develop an improved understanding of the complex interactions between radon progeny and other aerosols typically found indoors in homes and buildings so that an improved health risk estimate can be made for radon and its progeny.

2. Relevance to radon issue - This project will develop information on radon atmospheres in typical indoor environments. Accurate prediction of unattached fraction, equilibrium factor, and activity size distributions will enable a quantitative assessment of radon exposure and associated lung cancer risk under indoor environments.

DOE-113 Chromosome Damage in the 1 Rad Region: Cytogenetic Detection Following Ultra Low Doses and Dose Rates

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$126,000
* Status:	New
* Principal Contact:	Michael N. Cornforth Los Alamos National Laboratory P.O. Box 1663 Los Alamos, New Mexico 87545
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The overall goal of this project is to provide quantitative data concerning both the dose-response and repairability of cytogenetic damage to human cells caused by ultra low doses of densely ionizing radiation. Radiobiological data is desperately needed in the low dose region, not only for the sake of direct measurement, but also for the constraints such data are likely to place on models of radiation action that are currently used to assess low-level risk.

2. Relevance to radon issue - Total lung dose from ^{222}Rn in the U.S. varies widely, but generally is estimated to be well below 1 rad per year. At these low doses it is difficult to demonstrate a biological effect of any kind or to accurately determine the radiation-induced risk. Radiation biologists rely on a number of theoretical models of radiation action, based almost entirely on data available at high doses (i.e., hundreds of rads), to extrapolate risks for more relevant dose ranges. Depending on the model chosen, such extrapolations can lead to appreciable differences in estimated risk in the low dose region. A reasonable approach to the problem is to study a relevant biological endpoint (i.e. damage to chromosomal material), concentrating on the lowest doses practically measurable. This insures that the amount of extrapolation is minimized and the additional data gained in the low dose region would very likely serve to substantiate or refute models currently used to predict low level radiation hazards.

DEPARTMENT OF ENERGY

DOE-114 Mechanisms of Radon Injury

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$813,000
* Status:	Ongoing
* Principal Contact:	F.T. Cross Pacific Northwest Laboratories Biology and Chemistry Department P.O. Box 999 Richland, Washington 99352
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - For this project, molecular, cellular and whole-animal studies relevant to the inhalation toxicology of radon and radon-daughter exposures are being conducted. The studies address the exposure-rate effect in radon-daughter carcinogenesis; the induction-promotion relationships associated with radon and cigarette-smoke mixtures; the role of oncogenes in radon-induced cancers; the effects of radon exposure on DNA and on DNA repair processes; and the involvement of growth factors and receptors in radon-induced carcinogenesis. The results of these studies will provide a basic understanding of how inhaled radon causes lung tumors in animals. When coupled with microdosimetric information, they will provide a basis for understanding health-effects differences among species, particularly regarding tumor induction, and will aid in developing predictive models for man.

2. Relevance to radon issue - A fundamental understanding will be developed of the role of radon and associated pollutant exposures in the induction of lung cancer over the range of exposures normally encountered in the environment and in the work place. Forensic methods of implicating radon in mixed exposures will be developed if unique molecular markers are found to be associated with radon-induced cancers. (The identification of any cellular markers for premalignant cells as well as for various types of malignant cells may lead to early diagnosis of cancer and improved methods of treatment.) Associated developmental studies will determine potential risk of radon exposure to the fetus and newborn animal.

DOE-115 Radiation Dose and Injury to Critical Cells of the Respiratory Tract from Inhaled Radon

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$320,000
* Status:	Ongoing
* Principal Contact:	Richard G. Cuddihy Lovelace Inhalation Toxicology Research Institute P.O. Box 5890 Albuquerque, New Mexico 87185
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - Research in this project provides improved knowledge of the types and locations of cells that are irradiated by inhaled radon progeny to enable an improved dose estimation for cells that may subsequently produce lung cancer.

2. Relevance to radon issue - This information will be used to formulate appropriate relationships between radon and radon progeny concentrations in inhaled air and radiation dose to lung cells at risk. These studies will also compare the distributions of cell damage that result from exposures to radon progeny in air typical of buildings and uranium mines.

DEPARTMENT OF ENERGY

DOE-116 Studies of the Molecular Damage in Neoplastic Transformation Caused by Alpha Radiation from Radon Progeny

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$300,000
* Status:	Ongoing
* Principal Contact:	S. B. Curtis Lawrence Berkeley Laboratory Donner Laboratory 1 Cyclotron Road Berkeley, California 94720
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The goals of this study are to provide experimental information on the mechanisms of cell neoplastic transformation from low energy helium ions (alpha particles) at the physical, chemical, and molecular levels. Specifically our aims are (1) to measure transformation frequency of cells as a function of helium ion dose; (2) to investigate specific gene alterations in transformed human lung cells; (3) to determine the induction and repair of DNA strand breaks from alpha particle radiation in normal human lung cells; (4) to study relative amounts of direct and indirect damage to DNA; (5) to calculate ionization cluster-size frequencies in liquid water along tracks of alpha particles (6) to develop a quantitative model of neoplastic transformation from alpha particle radiation.

2. Relevance to radon issue - It is hoped that the knowledge gained through these studies and the resulting quantitative model will help to elucidate mechanisms of neoplastic transformation and tumor induction at low exposure levels of alpha particles so that extrapolations of cancer incidence to the levels and exposure rates present in residential dwellings can be put on a more scientific basis.

DOE-117 Indoor Atmospheric Chemistry: Interactions of Radon With Other Gaseous Pollutants

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$117,000
* Status:	New
* Principal Contact:	Joan M. Daisey Applied Science Division Lawrence Berkeley Laboratory University of California Berkeley, California 94720
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The goal of this research is to provide a fundamental understanding of the interactions of radon and its progeny with gaseous indoor pollutants found in high concentrations in homes. Ions, free radicals and neutral gaseous and particulate products generated by the radioactive decay of radon and its progeny in the presence of selected indoor organic pollutants, NO_2 and water vapor will be identified using mass spectrometric and laser-induced fluorescence methods. The rates of formation and activity-size distributions of the condensation nuclei products will be determined. Mechanisms of reaction will be investigated.

2. Relevance to radon issue - Physical and chemical characteristics of the products, rates of product formation and mechanisms of interaction of radon and its progeny with indoor pollutants will improve the basis for risk assessment for the general population exposed to radon in their homes, and for developing effective control strategies for risk reduction.

DEPARTMENT OF ENERGY

DOE-118 Investigation of Radon Entry and Effectiveness of Mitigation Measures

* Type of Activity:	Field study
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$150,000
* Status:	New
* Principal Contact:	C. S. Dudney Oak Ridge National Laboratory Health and Safety Research Division Oak Ridge, Tennessee 37831
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - This research is investigating factors that affect radon entry into selected houses in New Jersey and the Tennessee Valley. The objectives are: (1) to improve understanding of the physical processes underlying elevated levels of radon and radon progeny in houses and the impact of effective control measures, and (2) to evaluate and refine diagnostic protocols for implementation of effective mitigation strategies.

2. Relevance to radon issue - A major requirement necessary to reduce potential health impacts of elevated radon levels is to reduce in a cost-effective manner elevated levels (especially those >20 pCi/L) in houses. Factors that affect radon entry and mitigation effectiveness are varied and complex and include source availability (soil radium concentration, permeability, etc.), building factors (coupling, construction, etc.), and meteorological factors (wind, temperature, etc.). Analysis of the data will yield better understanding of (1) factors important to radon entry, (2) variations among houses in two regions of the country, and (3) models predicting radon entry. In addition, this research will produce effective diagnostic procedures that allow the selection of specific mitigation options with increased confidence that these measures will properly reduce radon levels under various environmental conditions.

DOE-121 Mutagenicity of Radon and Radon Daughters

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$151,000
* Status:	New
* Principal Contact:	Helen H. Evans Case Western Reserve University School of Medicine 2048 Adelbert Road Cleveland, Ohio 44186
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objective of this research is to investigate in detail the cytotoxic, mutagenic, and molecular lesions induced by exposure of mammalian cells differing in DNA repair capabilities to low dose rates of radon and radon daughters.

2. Relevance to radon issue - The mouse lymphoma cell is very sensitive to the cytotoxic and mutagenic effects of radiation and cellular responses are expected to be measured at very low doses and dose rates which approximate those encountered in the environment. The molecular analysis of the lesions so produced and the investigation of their reparability should yield information as to the mechanism of radon/radon daughter-induced cancer, as well as the risk of cancer induction under various conditions.

DEPARTMENT OF ENERGY

DOE-122 Microdosimetry of Radon Daughters

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$67,000
* Status:	New

* Principal Contact: Darrell R. Fisher
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* Other Contact: Susan Rose
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U.S. Department of Energy
(301) 353-5355

* Activity Description:

1. Research objectives - The purpose of this project is to develop analytical methods of calculating the microdosimetry, in terms of probability density in specific energy, of alpha particle and secondary electron interactions with nuclei of basal cells and secretory cells within the tracheobronchial epithelium from inhalation of radon and radon-daughter products. Site-specific microscopic dose distribution probabilities will be determined for biological targets important to the initiation of bronchogenic cancer from inhalation of radon and daughters. The relationship between the dose distribution at the cellular level will be compared to resulting biological effects so that the biological hazards of low-level exposures to radon and daughter products may be better understood and predicted.

2. Relevance to radon issue - The risks associated with inhalation or radon daughter products must be correlated with radiation dose so that biological effects may be understood and predicted. Current methods for estimating radiation dose to the lung from inhaled radon and daughters are generally satisfactory for worker radiation protection in underground uranium mines, but do not provide adequate means for assessing the risk from low-level environmental exposures. This project will develop information on the microscopic distribution of radon daughters in the lung and resulting microscopic patterns of energy deposition in critical target cell nuclei so that the probability of short-term and long-term biological effects may be determined. This work will help us understand the relative risks associated with low-level indoor radon exposures.

DOE-123 An Investigation of the Geology and Geochemistry of Radon in Shear Zones
(Same as DOI-106)

* Type of Activity:	Field study, basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$84,000
* Status:	New
* Principal Contact:	Linda C. Gunderson U.S. Department of Interior U.S. Geological Survey, National Center Reston, Virginia 22092
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - Mylonitic and cataclastic shear zones are known sites of uranium concentration and severe radon problems in homes. The processes which form shear zones and that are associated with their development are conducive to uranium accumulation. This study will provide the detailed geological and chemical analyses necessary to understand these processes and will evaluate their significance in a number of different lithologic and structural settings. In addition, the availability of radon gas in these settings will be studied as a function of soil development, permeability, and water-rock interaction. Systematic soil gas and ground water analyses will be incorporated into thermodynamic geochemical models which will provide insight into the processes which allow radon gas to mobilize. The study sites reflect a range of lithologies and structural settings that are analogous to shear zones in orogenic belts worldwide. Therefore, the results of this study should be universally applicable for these types of severe radon problems.

2. Relevance to radon issue - Shear zones have been identified with some of the highest indoor-radon and radon in water problems ever recorded in the United States. The most notable of these occur in Boyertown, Pennsylvania and Clinton, New Jersey. Uranium enrichment and increased permeability in shear zones are the two major controlling factors in the severity of the problems there. By developing models for radon in shear zones we will be capable of predicting potential radon problems in the other orogenic (and highly populated areas) of the United States. An understanding of the geology and the physical properties of these zones will also provide information useful to construction engineers who currently have problems mitigating these types of severe radon problems.

DEPARTMENT OF ENERGY

DOE-124 Fundamental Studies of Radon Release From Soil Constituents

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$120,000
* Status:	New
* Principal Contact:	Garman Harbottle Brookhaven National Laboratory Department of Chemistry Upton, New York 11987
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* Activity Description:

1. Research objectives - This project addresses the question of radon availability in the soil. If radium, the precursor of radon, were homogeneously distributed in soil grains, there would be very little radon escape. However, many soils release radon into the soil gas phase rather freely. It is the goal of this research to develop a comprehensive picture of the chemical and physical relationships pertaining to the loci of the radon precursors on or within the soil grains and the relationship between these properties and the ability of the soil to emanate radon.

2. Relevance to radon issue - The project examines the origin, mobility and chemical behavior of radon precursors in the soil, and so examines the very earliest steps of the process which culminates with the introduction of radon and its progeny into the human lung, the concomitant exposure of the lung tissue and the resultant cellular damage.

DOE-125 Measurement and Apportionment of Radon Source Terms for Modeling Indoor Environments

* Type of Activity:	Field study
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$83,000
* Status:	Ongoing
* Principal Contact:	Naomi H. Harley NYU Medical Center Department of Environmental Medicine 550 First Ave New York, New York 10016
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* Activity Description:

1. Research objectives - The first objective of this research is to quantitate the mechanisms for radon entry into homes of different types and determine the fraction of indoor radon attributable to each type of source whether pressure driven or diffusional. The second objective is to model the alpha dose to the human and animal tracheobronchial tree from inhaled radon daughters.

2. Relevance to radon issue - The apportionment of the sources of indoor radon is not well characterized. This study, with at least three types of homes is designed to model the sources of indoor radon. The bronchial dosimetry is needed to understand the health effects of indoor radon.

DEPARTMENT OF ENERGY

DOE-126 Atmospheric Chemistry of Po-218

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$80,000
* Status:	Ongoing
* Principal Contact:	Philip K. Hopke University of Illinois Institute of Environmental Studies 408 South Goodwin Urbana, Illinois 61801
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objective of this research is to (1) measure the neutralization rates for Polonium ions for each of the three identified mechanisms: small ion recombination, electron transfer, and electron scavenging, (2) investigate the mechanisms of radiolytic particle formation, and (3) determine the rates of production of oxidative free radicals by radon radiolysis.

2. Relevance to radon issue - The chemical and physical behavior of the radon decay product molecules is important in understanding activity size distributions, plateout, airborne alpha energy concentrations seen in indoor air as well as the respiratory deposition patterns of the decay products. The ability of the decay process to produce particles as well as induce other free radical indoor chemistry may be important to the understanding of both radiation-related health problems and the health effects of non-radioactive compounds produced by these reactions.

DOE-129 The Biological Significance of Radon-Induced Aneuploidy in Progenitor Cells of the Respiratory Tract

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$167,000
* Status:	New
* Principal Contact:	Neil F. Johnson Lovelace Inhalation Toxicology Research Institute P.O. Box 5890 Albuquerque, New Mexico 87185
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* Activity Description:

1. Research objectives - The goals of this project are to determine (1) whether there are cell type specific aneuploid (abnormal DNA content) and chromosomal aberrations associated with the respiratory tract epithelium following exposure to radon and radon progeny; (2) the biological significance of aneuploid changes in specific cells and at specific locations within the respiratory tract following exposure to radon and radon progeny; and (3) the phenotypic characteristics of aneuploid versus normal cells. Aneuploidy is generally considered a hallmark of neoplasia although its biological significance is poorly understood. This research will be used in determining the significance of alterations in the DNA content of critical cells in the respiratory tract following exposure to radon.

2. Relevance to radon issue - The data from these investigations will be used in assessing the risk to the general public from exposure to radon and radon progeny.

DEPARTMENT OF ENERGY

DOE-130 Activation of Oncogenes by Radon Progeny and X-rays

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$240,000
* Status:	New
* Principal Contact:	C. Clifton Ling University of California, San Francisco CED 200 P.O. Box 0806 San Francisco, California 94110
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The goal of this proposal is to study the carcinogenic effect of X-rays and alpha particles that simulate radon progeny at the molecular level utilizing the techniques developed in molecular biology, cancer cell biology and radiation biology. In vitro rodent cell models will be developed that reproduce the stepwise progression of normal cells towards the transformed phenotype.

2. Relevance to radon issue - There is a need to study the health hazard of environmental Rn-222 exposure, particularly due to the possible increase in Rn-222 levels in homes with energy saving devices. By employing both alpha particles and X-rays, the linear energy transfer (LET) dependence of radiation activation of oncogenes can be examined.

DOE-131 Indoor Radon, Thoron, and the Related Aerosols

* Type of Activity:	Applied research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$1,250,000
* Status:	Ongoing
* Principal Contact:	Wayne M. Lowder Environmental Measurements Laboratory Radiation Physics Division 376 Hudson Street New York, New York 10014
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* Activity Description:

1. Research objectives - The objective of this project is the metrology of indoor radon, thoron, their progeny, and the related aerosols.

2. Relevance to radon issue - These studies will provide tests of models of the indoor atmosphere that relate radon measurements made under various conditions to the resulting dose to the critical cells, and thus to health risk.

DEPARTMENT OF ENERGY

DOE-132 Aerosol Microphysics of Indoor Radon

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$140,000
* Status:	Ongoing
* Principal Contact:	William H. Marlow Texas A & M University Department of Nuclear Engineering P.O. Box 3578 College Station, Texas 77843
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* Activity Description:

1. Research objectives - Radioactive daughter atoms from the decays of radon gas are associated with submicrometer particles and molecular clusters in the indoor aerosol. To support laboratory investigations and modeling of these radon decay products which constitute a risk to human health, studies of the physics of formation, interaction, and electrical charging of these aerosols will be conducted.

2. Relevance to radon issue - This work contributes to the construction of models of indoor radon decay product evolution under realistic environmental conditions in two ways: (1) The collaboration with laboratory and experimental efforts assists in the acquisition of data needed for modeling. (2) Our theoretical-computational work contributes several essential components to the mathematical models of indoor radon.

DOE-133 Determination of the Cell and Mucous Distribution in the Airways of the Lung for Modeling Injury Due to Inhaled Radon and Radon Daughters

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$95,000
* Status:	New
* Principal Contact:	Robert R. Mercer Duke University Department of Medicine Box 3177 Durham, North Carolina 27710
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* Activity Description:

1. Research objectives - The objective of this study is to provide detailed data necessary for determining target regions of the lung for inhaled radon and radon progeny and to determine the sensitivity of the cell types located in the target region(s). This will be done by a morphometric study of the various cell types and the mucous lining layer(s) in the lungs. Advances in mathematical modeling, when coupled with quantitative anatomical data, will permit determination of the target region(s) for inhaled pollutants.

2. Relevance to radon issue - The study is designed to provide results necessary for significant advances in the estimation of health risks associated with human exposures to radon and radon progeny. In the proposed study, for the first time, the orientation and depth of the nucleus for each of the various cell types in large and small airways will be determined. This will provide critical data for calculation of the radiation dose to cells following inhalation of radon progeny.

DEPARTMENT OF ENERGY

DOE-134 Mutations in Shuttle Plasmids

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$81,000
* Status:	New
* Principal Contact:	Sankar Mitra Oak Ridge National Laboratory Biology Division Oak Ridge, Tennessee 37831
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* Activity Description:

1. Research objectives - It is important to understand the molecular basis for genetic and somatic changes in humans following exposure to ionizing radiation for estimating adverse health effects of radiation to human populations. One of the recently available strategies for studying the nature of mutation in mammalian cells is to utilize a recombinant shuttle plasmid containing a target gene. Various agents and conditions that are known to modulate the effects of radiation will also be tested for their effects upon mutational yield and quality. Furthermore, chromosomal abnormalities including deletions and translocations in these host cells will be quantitated to compare the microscopic and molecular effects of radiation. The major emphasis of this task is to determine the effectiveness of a-particles and X-rays to induce mutations.

2. Relevance to radon issue - Data will be provided on the mechanism of induction of mutations by ionizing radiations, and also, of particular importance to determine the relative effectiveness of mutation induction by X-rays and a- particles. This latter information will form part of the basis for making estimates of the induction of mutations by radon in man.

DOE-135 Initiation-Promotion-Initiation Experiments with Radon and Cigarette Smoke: Lung Tumors in Rats

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$67,000
* Status:	New
* Principal Contact:	Suresh H. Moolgavkar Fred Hutchinson Cancer Research Center Public Health Sciences Division 1124 Columbia Street Seattle, Washington 98104
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* Activity Description:

1. Research objectives - The objective of this research is to study the interaction of radon and cigarette smoke in causing lung tumors in rats. An initiation-promotion-initiation (IPI) experiment with radon as initiator and cigarette smoke as promoter is being conducted at Battelle Laboratories in Richland, Washington. The end point of interest is the appearance of lung tumors in rats. The data will be analyzed using modern methods of censored survival analysis. Further, a biologically-based two mutation model for carcinogenesis, which has previously been shown to be consistent with a large body of experimental and epidemiologic data, and on the basis of which the IPI protocol was designed, will be fit to the data. Conclusions regarding the mechanism of action of radon and cigarette smoke in causing lung tumors will be sought.

2. Relevance to radon issue - This study will provide information regarding the interaction of cigarette smoke and radon in causing lung tumors, an important area of uncertainty in developing risk estimates.

DEPARTMENT OF ENERGY

DOE-136 Characterization of Airborne Radon Concentrations

* Type of Activity:	Basic research, field study
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$413,000
* Status:	Ongoing
* Principal Contact:	Anthony Nero Indoor Environment Program Applied Science Division Lawrence Berkeley Laboratory University of California Berkeley, California 94720
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* Activity Description:

1. Research objectives - The purpose of this project is to characterize the sources and concentrations of indoor radon, with particular attention to processes that affect the transport of radon into buildings and the build-up and removal processes for radon progeny in indoor air. This project investigates the manifold of factors affecting generation, entry and removal of radon, and the factors influencing the behavior or radon progeny indoors in order to (1) assess the associated exposure and health risks, and (2) understand influencing factors so that they may be used as a basis for identifying where excessive levels may occur and for developing control measures appropriate to such occurrences.

2. Relevance to radon issue - Assessment of the nature, extent and variability of the problem is dependent upon detailed research. Utilization of such research results combined with the predictive approach discussed in item 2 is important to the appraisal of the geographic extent of the problem of elevated indoor concentrations. With the rapid expansion in measurements and reported results from various research projects, integration and assessment of such data into a consistent framework is essential to providing research guidance.

DOE-137 A Unifying Theory of Radon Generation and Transport in Porous Media

* Type of Activity:	Basic research, computer modeling
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$44,000
* Status:	New
* Principal Contact:	Kirk K. Nielson Rogers & Associates Engineering Corp. P.O. Box 330 Salt Lake City, Utah 84110
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The research objectives of this project are to develop a general, unified theory of radon emanation and transport and to implement it in a computer code for application in routine and specialized field studies and research programs. The theoretical development is to bridge present gaps in radon emanation and radon transport theory, and to make compatible various models of radon emanation, moisture effects, diffusive transport, and advective transport. The resulting theoretical understanding and computer model will provide the necessary mathematical tools to correctly characterize radon source potentials for indoor radon accumulation. The unified theory will simultaneously consider diffusive presence of any radium concentration and emanation potential. It will provide for correct analysis of the effects and interactions of measured source parameters, including radon emanation variations, soil moisture effects, and rates of radon release in the presence of varying diffusion conditions and advective velocities of soil gas.

2. Relevance to radon issue - Significant research efforts within DOE, EPA, and state agencies are attempting to model and predict indoor radon concentrations from basic, measurable parameters. By correctly defining radon availability and transport in the soil and the radon source potential of an environment, the unified theory will directly support the needs and efforts of these other research programs. In addition, it will define parameter sensitivities so that expensive field programs can concentrate resources on measuring the most useful parameters and extract the most meaningful correlations from field data.

DEPARTMENT OF ENERGY

DOE-138 Radon Transport Modeling in Soils

* Type of Activity:	Computer modeling
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$133,000
* Status:	New
* Principal Contact:	Peter C. Owczarski Pacific Northwest Laboratories P.O. Box 999 Richland, Washington 99352
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* Activity Description:

1. Research objectives - The goals of this project are to construct and apply a comprehensive computer-based model of radon transport within and from soils into the atmosphere and structures. The model will be developed to solve all pertinent unsteady-state differential equations governing the transport of radon, soil gas, liquid and vapor water, and energy. The model will be 3-dimensional, unsteady state, and multiphase. Boundary conditions imposed at the soil surface will be designed to simulate temporal changes in air pressure and temperature due to atmospheric changes or the presence of buildings. The transport equations will contain all suitable soil parameters and radon emanation characteristics. The model will be validated as far as existing and near-future data allow.

2. Relevance to radon issue - This project is directly related to the future understanding of the major source of indoor radon, namely, soils around buildings.

DOE-139 Basic Studies of Radon and Related Po and Pb Radioisotopes

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$50,000
* Status:	New

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* Activity Description:

1. Research objectives - The purpose of this research activity is to provide detailed information about the transport pathways of ^{222}Rn, ^{214}Pb, ^{214}Bi, ^{214}Po, ^{210}Pb, and ^{210}Po. The studies will yield information about the charge states of thermalized decay products, the effects of clustering on the decay products, the mobility of decay products, the sticking coefficients of both ionic and neutral products with various materials, the release of decay products from solid surfaces as a result of recoil in alpha decay, the diffusion of radon and its progeny, and the sticking time of radon to various solids.

2. Relevance to radon issue - Discussions of the pathways by which the progeny of radon attach to dust particles and enter the lungs have been highly phenomenological. Research performed in this activity should quantify much of the unknown physical quantities affecting indoor radon exposure. For example, methods for unfolding energy spectra and emitted alpha particles will be investigated in connection with recording positions and the environment of the alpha emitter. This basic information should make possible a more fundamental approach to the modeling of the transport of radon and the other radioisotopes which are involved in the evaluation of risk

DEPARTMENT OF ENERGY

DOE-140 Dosimetry and Cell Killing

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$117,000
* Status:	New
* Principal Contact:	M. R. Raju Los Alamos National Laboratory P.O. Box 1663 Los Alamos, New Mexico 87545
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objectives of this project are: (1) to provide an alpha particle exposure facility and the related dosimetry for all of the investigators from the Life Sciences Division, and (2) to conduct basic studies of the mechanisms of cell killing by alpha particles.

2. Relevance to radon issue - The proposed studies provide information on basic mechanisms of cell lethality induced by alpha-particles.

DOE-141 Cellular Morphometry of Human and Dog Lungs

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$64,000
* Status:	New
* Principal Contact:	Edith S. Robbins NYU Medical Center Department of Cell Biology 550 First Avenue New York, New York 10016
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* Activity Description:

1. Research objectives - The objectives of this research are to describe and quantitate the cell populations in the epithelial lining and submucosal glands of human and dog lung bronchi (airway generations 2-6). The information to be generated will include airway diameters, cells of the different types (ciliated, mucous, serous, small-granule, basal, indeterminate etc.) per unit area, volume density of all the cell types with special focus on the basal and other potential stem cells, and determination of the distances of cellular nuclei from the airway lumen. Human bronchial cell populations from the same generation and lobe airways from individuals of different ages, sex and smoking status will be compared as specimen availability allows. Canine bronchi will be quantitated similarly and used to perfect the techniques for the human tissue studies.

2. Relevance to radon issue - Models which calculate risk based on alpha doses from radon daughters currently depend on incomplete and inadequate basic human morphological data which were generated from an old (1972) light microscopic study which examined only paraffin sections. Detailed, high quality cellular morphometric quantitation of the cell population of the epithelia and glands of human bronchi, upon which radon daughter risk model calculations can be based, do not exist and are essential. Additionally, information as to human airway cellular differences as functions of age, sex and smoking history have not been described and these will be of considerable scientific importance as well.

DEPARTMENT OF ENERGY

DOE-142 Generation and Mobility of Radon in Soil

* Type of Activity:	Basic research, field study
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$100,000
* Status:	New
* Principal Contact:	Arthur W. Rose The Pennsylvania State University College of Earth and Mineral Science University Park, Pennsylvania 16802
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - Research is being conducted to determine: (1) the relationships between radon in soil gas, radon emanation, form and distribution of radium in soil, soil moisture, porosity, soil type, soil depth, weathering and soil profile development, and (2) the extent of leaching and mobility of uranium, radium and other uranium progeny in a variety of soil types in Eastern U.S.

2. Relevance to radon issue - Because the major source of radon in homes is nearly always from soil, the variability from region to region and from house to house is partly dependent on soil characteristics, such as uranium content, proportion of radon emanated from solids into soil gas, the portion of the bulk soil volume occupied by gas, and transport of radon through soil to the house. An understanding of radon generation and transport in soils will allow better prediction of relative hazard on a local and regional basis, and possibly aid in ameliorating problems and developing better construction practices.

DOE-143 Health Effects of Radon Daughter Exposure in Uranium Miners of New Mexico

* Type of Activity:	Epidemiology
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$117,000
* Status:	Ongoing

* Principal Contact: Jonathan M. Samet
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* Activity Description:

1. Research objectives - This project will utilize the research opportunity offered by the New Mexico uranium miners to assess effects of radon progeny exposure at levels lower than in most previous studies and at levels generally below those received by uranium miners in the Colorado Plateau. A cohort of underground uranium miners who have worked in New Mexico has been established. Exposure records maintained by the state and the mining industry provide documentation of the miners' exposure to radon progeny; and records of health examinations provide information on cigarette smoking for the majority of the miners.

2. Relevance to radon issue - The study will describe the exposure-response relationship of lung cancer with radon progeny in a range of exposure extending from a few Working Level Months up to about 1,000 Working Level Months. This range of exposure is relevant to those received in many homes; thus, risk estimates derived from this study will contribute to risk assessment for radon progeny in indoor air. Additionally, this study is one of the few investigations with information on cigarette smoking. Analysis will provide insights into the interaction between cigarette smoking and exposure to radon progeny. Understanding this interaction is essential for describing the lung cancer risks associated with exposure to radon progeny for smokers and for nonsmokers in the general population.

DEPARTMENT OF ENERGY

DOE-144 Physical Processes Important to Airborne Radioactivity in Enclosed Environments

* Type of Activity:	Basic research, field study, applied research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$71,000
* Status:	New
* Principal Contact:	Stephen D. Schery New Mexico Institute of Mining and Technology Department of Physics Socorro, New Mexico 87801
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objective is to improve our understanding of fundamental processes influencing release of radon isotopes from porous media and the physical properties of radon isotopes, their progeny, and ions and aerosols in enclosed environments. Current emphasis is studying sorption of radon on porous media. Porous samples such as soil, rock, and concrete are exposed to radon in the laboratory at varying moistures and temperatures. After correction for the effects of pore space, the effective sorption coefficient is deduced for each sample. Data on sorption as a function of time, temperature, and moisture will be used to study the physical mechanisms responsible for sorption.

2. Relevance to radon issue - Desorption due to moisture or temperature increase has been proposed as an important factor leading to enhanced release of radon to air. Based on theoretical grounds it is not clear that typical porous media at the commonly encountered moistures are capable of significant conventional physical adsorption. The measurements should provide information on the magnitude and mechanisms of sorption, and whether or not sorption is significant enough in common porous media to explain the releases of radon reported in the literature.

DOE-145 Analysis of DNA Damage and Mutation Induced by Radon Daughter Products

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$171,000
* Status:	New

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U.S. Department of Energy
(301) 353-5355

* Activity Description:

1. Research objectives - In order to understand the genetic and somatic risks associated with exposure to radon and its daughter products, it is important to characterize those lesions that lead to mutation induction and carcinogenesis. In this project we plan to examine DNA damage and mutations induced in both human and Chinese hamster cell lines exposed to radon daughter products. This analysis will be carried out by combining (1) cellular assays of cytotoxicity and mutagenicity with (2) biochemical assays of DNA damage and repair and (3) cytogenetic and molecular assays of mutation induction in Chinese hamster ovary and human cell lines.

2. Relevance to radon issue - These studies should lead to a better understanding of the carcinogenic risks of radon exposure because we will determine how cellular factors such as DNA repair affect response to radon exposure as well as the spectrum of mutational events induced by exposure.

DEPARTMENT OF ENERGY

DOE-146 Cellular Mechanisms of Radon-Induced Lung Tissue Injury In Vitro

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$133,000
* Status:	New

* Principal Contact:	Thomas M. Seed Argonne National Laboratory Biological, Environmental and Medical Research Division 9700 South Cass Avenue Argonne, Illinois 60439
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* Activity Description:

1. Research objectives - The overall goal of this study is to elucidate basic cellular mechanisms of pulmonary tissue injury arising from radon/radon-daughter exposure and establishing in vitro dose-response relationships for three individual or cooperative cellular responses (cytotoxicity, mutagenicity, and transformation) in three major pulmonary cell targets (macrophages, reticular fibrocytes, and basal epithelial cells).

2. Relevance to radon issue - The elucidation of the basic cytotoxic and modified cell functions of cooperating cell types (macrophages and reticular fibrocytes) and the mutagenic and transforming responses of epithelial target cells to the gaseous radionuclide ^{222}Rn and its reactive daughters in vitro will support the establishment of a data base of elemental pulmonary target cell responses elicited by radon/radon-daughter exposure. The data base established in this project should provide a scientifically sound foundation to aid in the development of more accurate pathologic risk assessments associated with chronic low-dose exposure in man.

DOE-147 Experimental and Theoretical Investigations of Radon Availability, Migration and Entry

* Type of Activity:	Field study, applied research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$333,000
* Status:	New

* Principal Contact:

Richard Sextro
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* Other Contact:

Susan Rose
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* Activity Description:

1. Research objectives - The purpose of this project is to investigate radon availability, migration through soils and entry into houses. This work will examine and model the influence of various environmental factors on radon production and migration through soils under the influence of a pressure-field in the soil established by the pressures across the shell of a small structure with controlled leakage characteristics. The coupling between this structure and the surrounding soil will be investigated, with particular attention to the effects of heterogeneities in both the soil and the leakage characteristics of the building shell. Differences in steady-state and time-dependent pressure fields will be examined. The role of local geology and soil composition, particularly air permeability, in radon availability and migration will also be studied. Although principally focused on radon-222, measurements and calculations involving radon-220 will also be included in the study. The experimental and theoretical research will proceed as parallel but coupled processes, with experimental results providing tests of and feedback on the model components while the model will be used as a tool to help design experiments and to assist in the interpretation of complex experimental data.

2. Relevance to radon issue - The experimental and theoretical studies undertaken in this project will provide a better scientific basis for evaluating the radon potential of existing and new buildings, and will assist in designing more reliable and cost-effective control approaches.

DEPARTMENT OF ENERGY

DOE-148 Radon Permeability in Soil: A Method For Prediction

* Type of Activity:	Field study
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$133,000
* Status:	New

* Principal Contact: Joseph H. Shinn
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* Activity Description:

1. Research objectives - The goal of this research is to develop and verify a method of estimating radon permeability in soil. Specifically, there are two objectives: (1) to derive the bulk permeability of radon from direct observation of radon flux in soils that are uniform and well-characterized and (2) to demonstrate that this observed radon permeability is related to readily measurable soil properties of particle size, water permeability, soil-water content, and porosity.

2. Relevance to radon issue - The radon gas formed by alpha decay of radium in soils is a major source of radon found in homes. While soil gas flow into residences has been demonstrated, no detailed understanding of the important factors affecting the source strength of radon has yet emerged. The prediction of radon permeability in soil is an issue that remains to be resolved in order to evaluate the local importance of radon sources in potential human exposures.

DOE-149 Radon Dynamics Indoors

* Type of Activity:	Field study
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$75,000
* Status:	New
* Principal Contact:	R. H. Socolow Center for Energy and Environmental Studies Princeton University Princeton, New Jersey 08544
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objective of this research is to achieve a better understanding of the movement of radon gas and radon progeny within a house and the attachment of progeny to indoor aerosols. We will perform field experiments in two houses. The combined use of nuclear and tracer gas instrumentation has illuminated the role of heating and air conditioning (HAC) operation in perturbing the movement of radon and radon progeny in various zones of a house; we will use this combined approach extensively in the proposed work. We will also provide a detailed analysis of the data on radon dynamics obtained in the Piedmont study.

2. Relevance to radon issue - In this work, we are working toward a better understanding of how radon and radon progeny move indoors, with sensitivity to the details of the dynamics of house ventilation (including the operation of forced air furnaces and air conditioners) and to the aerosol content of indoor air.

DEPARTMENT OF ENERGY

DOE-150 Lung Cancer Risks from Radon Daughters in Domestic Environments

* Type of Activity:	Epidemiology
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$400,000
* Status:	Ongoing
* Principal Contact:	James H. Stebbings Argonne National Laboratory Biomedical and Medical Research 9700 South Cass Avenue Argonne, Illinois 60439
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objective of this study is to ascertain directly whether radon daughters in the domestic environment measurably increase risks of lung cancer for the population in general, and specifically for females. The different histopathologic types of lung cancer are to be investigated separately, as are effects in active tobacco smokers and nonsmokers. Effects of passive smoking are to be estimated. Emphases are on the dose-response and dose-latency relationships specific both to tobacco smoking status and to each cell type of lung cancer. The initial effort involves a study of approximately 500 cases of lung cancer among the total female population of a region in Pennsylvania.

2. Relevance to radon issue - These studies will determine directly if exposures to radon progeny in homes increase respiratory tract cancer risks for both smoking and nonsmoking female residents as is predicted by current dose-response relationships derived from studies of male hard-rock miners.

DOE-151 Regional Aerosol Deposition in Human Upper Airways

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$74,000
* Status:	Ongoing

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* Other Contact: Susan Rose
Radon Program Manager
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(301) 353-5355

* Activity Description:

1. Research objectives - The objective of this research program is to elucidate important factors which influence overall and local deposition of aerosols in the human airways above the trachea including the nasal passage, oral passage, pharynx, and larynx. This information is important for the development of dosimetric models for radon daughter and other environmentally significant airborne particles. Of particular interest are the effects of flow rate, particle diameter, and airway dimension, especially as affected by age and respiratory condition. It has been hypothesized that the upper airways of nonadults are <u>not</u> scaled versions of adults, and thus must be treated separately when modeling respiratory tract deposition.

2. Relevance to radon issue - Radon progeny exist either as unattached particles or are attached to larger aerosol particles. Their distribution in the respiratory tract is poorly understood, especially with regard to particle sizes smaller than 0.5 um. Of particular interest is the influence of breathing mode (nasal or oronasal), breathing condition, and airway configuration. No information exists to model respiratory distribution of such aerosols for humans other than normal adults and little information exists even for them. This research is designed to provide new information on upper airway deposition addressing these issues.

DEPARTMENT OF ENERGY

DOE-152 Gas Transport in Soils and its Relation to Radon Availability
(Same as DOI-103)

* Type of Activity:	Field study, applied research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$170,000
* Status:	Ongoing

* Principal Contact:

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* Other Contact:

Susan Rose
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* Activity Description:

1. Research objectives - Although the principles of radon movement in idealized, homogeneous ground have been established, the allowances needed for vertical and lateral inhomogeneities, anisotropy, and variable moisture content of the ground are currently understood only qualitatively. The objective of the present research is to furnish more quantitative information about the range and variability of diffusive and advective-convective transport of radon and its controlling factors at selected sites. The improved knowledge should enable more realistic modeling of radon movement in the ground to building foundations and more accurate prediction of the potential radon entry into them.

2. Relevance to radon issue - The concentration of radon in soil gas and the ease of radon movement through soil or fractured rock to building foundations are two of the critical components of radon entry. In turn, the layering of soils and the variation of soil water saturation profoundly affect the pathways available and the speed of radon movement. This project is intended to define the pathways better and to enable more accurate estimation of the variability of the speed of radon movement in response to meteorological and seasonal factors.

DOE-153 The Carcinogenic Effects of Alpha-Particle Radiation on Tracheal Cells

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$151,000
* Status:	New
* Principal Contact:	M. Terzaghi-Howe Oak Ridge National Laboratories Biology Division P.O. Box Y Oak Ridge, Tennessee 37831
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives -

   The objectives of this research are to: (1) determine the dose-response relationships of the induction of neoplastic transformation by x-rays, fission neutrons and alpha particles, (2) determine the effect of dose rate on the induction of cancer by alpha particles and fission neutrons, (3) determine if neoplastic transformation of rat respiratory epithelial cells exposed to radon involves specific oncogene alterations, particularly in the ras family and other oncogenes, such as myc, that may exert a cooperative effect in causing expression of neoplastic phenotypes, (4) search for other genetic changes, such as possible activation by alpha-particle radiation of transposition mechanisms in endogenous mobile gene elements that may induce cellular gene rearrangement and genomic instability in rat respiratory cells, (5) determine whether or not specific chromosome changes are involved in the malignant transformation of rat tracheal cells by alpha particles and other radiations, and (6) determine the relative biological effectiveness (RBE) of alpha particles to induce chromosome aberrations.

2. Relevance to radon issue - There is a clear need for development of a model system to evaluate the influence of dose and dose-rate on the biological effects of alpha-particle exposure in respiratory tissues. The rat tracheal model would allow for evaluation of alpha-particle induced effects on respiratory tissues under conditions which most closely mimic those occurring in the intact tissue while also allowing for accurate dosimetry.

DEPARTMENT OF ENERGY

DOE-154 An Investigation of Radon Release and Mobility in the Subsurface Environment

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$45,000
* Status:	New

* Principal Contact:	Donald Thomas University of Hawaii at Manoa Hawaii Institute of Geophysics 2525 Correa Road Honolulu, Hawaii 96822
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* Activity Description:

1. Research objectives - The proposed investigation has three broad objectives: (1) the characterization and quantification of the influence of environmental factors on the mobility of radon in the subsurface and at the soil/air interface including the effects of rainfall, wind speed, soil moisture, synoptic and diurnal barometric pressure changes, and soil permeability; (2) a preliminary analysis of the effects of engineered structures on radon mobility in the shallow soil layer; and (3) an evaluation of possible mitigation measures that might be employed to reduce radon entry into structures. A longer-term objective of this work is to develop a mathematical model of gas transport processes occurring in the subsurface environment that can be applied to radon entry into structures and to the transport of other environmentally sensitive volatile species.

2. Relevance to radon issue - Quantification of the radon response to environmental variables will aid in the development of a broad-based model for ground gas transport in the natural environment and in response to changes induced by engineered structures. Application of this model on a national or regional basis will assist in the identification of existing structures that are at risk of high radon exposure and that should be tested directly. The model would also assist in the development of design modifications that could be applied to new construction in order to reduce radon exposure.

DOE-155 Radon-Induced DNA Damage and Cell Transformation in Respiratory Epithelial Cells

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$180,000
* Status:	New

* Principal Contact: David G. Thomassen
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* Activity Description:

1. Research objectives - The purpose of this research is to determine the direct effects of radon progeny and other high-LET radiation on respiratory epithelial cells and to investigate the mechanism of radiation carcinogenesis. Cultures of rat tracheal epithelial cells established following irradiation of cells in vivo or in vitro will be examined for radiation-induced DNA strand breaks and chromosomal aberrations, as estimators of radiation dose, and for cell transformation. Comparisons will be made of the effects caused by low- and high-LET radiation, of dose-rate effects, and of dose-response relationships for radiation-induced cell transformation. The role of high-versus low-LET radiation in carcinogenesis will be examined by comparing the phenotypes of radiation-induced preneoplastic variants, by determining the role of radiation-induced aneuploidy in preneoplastic transformation, and by determining the role of radiation at early versus late stages of the carcinogenic process.

2. Relevance to radon issue - Understanding the mechanism of high- versus low-LET radiation-induced cell transformation and the role of these two types of radiation in early or late stages of carcinogenesis will be useful in developing models for radiation-induced respiratory carcinogenesis and for improved estimates of dose to target tissues for high-LET radiation of respiratory epithelium. This information will be important in determining the direct risk from exposure to radon progeny in the home environment and for identifying important factors that modify that risk.

DEPARTMENT OF ENERGY

DOE-156 Assessment of Indoor Thoron and its Progeny

* Type of Activity:	Field study
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$133,000
* Status:	New
* Principal Contact:	R. E. Toohey Argonne National Laboratory Biological, Environmental and Medical Division 9700 South Cass Avenue Argonne, Illinois 60439
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - This project seeks to determine if indoor levels of thoron (^{220}Rn) make a significant contribution to the radiation dose received by man from the environment. The specific aims are (a) to investigate indoor thoron and progeny levels in typical U.S. single-family housing in a systematic manner; (b) to measure thoron and its progeny levels simultaneously with those building, environmental, and meteorological parameters expected to affect them, and (c) to develop a model for the indoor behavior of thoron and its progeny that can assess the effectiveness of current remedial measures.

2. Relevance to radon issue - The project focuses on an issue that has not been well investigated, despite an explosion in radon research over the last decade. The potential alpha energy concentration of thoron progeny in indoor air can, under some circumstances, be comparable to that of radon progeny.

DOE-157 The Determination of ^{222}Rn Flux from Soils Based on ^{210}Pb and ^{226}Ra Disequilibrium

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$100,000
* Status:	Ongoing
* Principal Contact:	Karl K. Turekian Yale University Dept. of Geology and Geophysics P.O. Box 6666 New Haven, Connecticut 06511
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - Release of ^{222}Rn from soils to the atmosphere is our most immediate clue to the probable release of radon to a structure overlying or intruding a soil profile. Factors affecting the release of radon from soils and rocks and its transport to the atmosphere are the following:

   (1) The ^{226}Ra concentrations the soil
   (2) The emanating efficiency of ^{222}Rn from the solid phase
   (3) The mobility of ^{222}Rn in the soil pore space and efficiency of escape to the atmosphere

   Although there is linkage among these three, they can be approached as independent factors.

2. Relevance to radon issue - The goal of this project is to identify a simple parameter that can be used to estimate the potential hazards of radon at any site under consideration for building or prolonged habitation by measuring the long-term radon flux from soils to the air.

DEPARTMENT OF ENERGY

DOE-158 Mechanisms of Radiation Damage to DNA From Radon Daughters

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$83,000
* Status:	New
* Principal Contact:	James E. Turner Oak Ridge National Laboratory Biology Division Oak Ridge, Tennessee 37831-6123
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The objectives of the program are (1) to understand the early physical and chemical changes produced in tissue by energetic alpha particles; (2) to elucidate the mechanisms of damage to biological molecules, particularly DNA; (3) to compare mechanisms of alpha-particle damage with damage from other types of radiation; and (4) to provide the fundamental physical basis for the dosimetry and microdosimetry of alpha-particle tracks.

2. Relevance to radon issue - Understanding mechanisms of damage from radon progeny is needed for comparing and quantifying the risks from exposure to indoor radon with other hazards. Such understanding is essential to provide a sound basis for dose-level extrapolations. Knowledge of such mechanisms could lead to improved and more relevant dosimetry.

DOE-159 Yields of Biologically Significant Damage Produced in Mammalian DNA by Radiation Associated with Radon Decay

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$138,000
* Status:	New
* Principal Contact:	John F. Ward University of California Radiology/Radiation Biology M-010 La Jolla, California 92093
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - In this work the types and yields of damage produced in mammalian cell DNA by 5 MeV alpha particles will be defined and compared to the yields of such damage produced by low LET radiation.

2. Relevance to radon issue - Since damage to DNA is accepted to be the source of the biological effects of ionizing radiation, it is important to determine the types of damage produced in this molecule by the alpha particles emitted from radon progeny.

DEPARTMENT OF ENERGY

DOE-160 Effects of Vegetation on Radon Transport Processes in Soil

* Type of Activity:	Field study, basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$156,000
* Status:	Ongoing
* Principal Contact:	F. Ward Whicker Department of Radiology and Radiation Biology Colorado State University Fort Collins, Colorado 80523
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - This research will test the main hypothesis that plant functions increase soil radon flow to the atmosphere, thus measurably reducing the flow into subsurface spaces. Research has shown that vegetation can significantly enhance the escape of soil radon to the atmosphere. Several possible mechanisms, including soil drying, soil permeability enhancement, and evapotranspirational flux apparently contribute to this phenomenon, but the relative importance of each of these mechanisms has not been quantified. Because plants and their functions can alter radon dynamics in soil, they may, in some cases, be an important source of variation for radon transport into subterranean spaces. This research will examine this possibility and will also provide information concerning the mechanisms of vegetation influence on radon transport through modifications in soil moisture and temperature and soil gas-basement pressure differentials.

2. Relevance to radon issue - This research will determine whether or not vegetation can be a significant source of variation for indoor radon concentrations. Should vegetation prove to be a significant source of variation, this factor may be useful in understanding, predicting, and possibly mitigating indoor radon levels in general. The study design will, irrespective of the influence of vegetation, enhance our understanding of soil and climatic variables on radon transport into subterranean spaces such as basements. The experimental radon facility will provide a good opportunity to test the predictive accuracy of radon transport models.

DOE-161 Laser Measurements of ^{210}Pb

* Type of Activity:	Instrument development, applied research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$93,000
* Status:	New
* Principal Contact:	Tom J. Whitaker Pacific Northwest Laboratories P.O. Box 999 Richland, Washington 99352
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - The purpose of the project is to correlate ^{210}Pb:^{208}Pb ratios in human tissue and radon exposure. The ultimate goal will be to develop a method of measuring radon exposures in humans, days or years after a sustained or major exposure occurs. The technique developed will have adequate selectivity to analyze ^{210}Pb in the presence of 10^{10} excess of stable Pb isotopes and will be sensitive enough to measure ^{210}Pb:^{208}Pb ratios in extremely small samples, such as a few day's growth of hair. The new technique utilizes laser ionization to provide efficient, isotopically selective ionization for mass spectrometric analysis. By measuring the ratio of ^{210}Pb to a stable Pb isotope, it should be possible to normalize for some fluctuations in the ^{210}Pb concentration caused by diet. A database will be established for ^{210}Pb:^{208}Pb ratios in foods so the effect of diet can be assessed.

2. Relevance to radon issue - Lead-210 is the first long-lived isotope in the ^{222}Rn decay chain. It has been widely studied because it is the source of a significant fraction of the total radiation dose to man. A correlation has been found between ^{210}Pb in blood, hair, and whiskers and occupational exposure to radon and its daughters by uranium miners. The level in blood could give a very sensitive measure of recent exposure, the level in hair could provide a convenient record over several months, and the level in bone would indicate the accumulated exposure over several years. This type of information could be useful in determining total exposure to occupants of homes found to be high in radon. It might also be useful in litigation cases. Furthermore, a rapid, sensitive method of measuring ^{210}Pb would benefit studies on the fate of ^{210}Pb in the environment and the deposition of ^{210}Pb in body tissues.

DEPARTMENT OF ENERGY

DOE-162 Repair of Alpha Particle-Induced Cytogenetic Damage

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$51,000
* Status:	New
* Principal Contact:	Sheldon Wolff Laboratory of Radiobiology and Environmental Health University of California San Francisco, California 94143
* Other Contact:	Susan Rose Radon Program Manager U.S. Department of Energy (301) 353-5355

* Activity Description:

1. Research objectives - Radon and radon daughters, which emit alpha particle could contribute to the induction of certain types of cancer. Chromosome breaks induced by densely ionizing (high-LET) radiations such as a rays are much less repairable than are chromosome breaks induced by sparsely ionizing (low-LET) radiations such as X-rays. Very low doses of X-rays are able to induce a novel repair mechanism that makes human lymphocytes less susceptible to induction of chromosome aberrations produced by agents that induce double-strand breaks in DNA, i.e., high doses of X-rays or exposure to bleomycin. Because of the importance of chromosome aberrations in the genesis of mutations and cancer that might be induced by alpha particles, the objective of this research is to study how the mechanisms involved in the novel radiation-induced repair mechanism affect alpha particle-induced cytogenetic damage and if the lesions induced by low doses of densely ionizing alpha particles can also induce the repair mechanism.

2. Relevance to radon issue - The experiments also should show whether or not exposure to high-LET radiation from a rays, which produce a different spectrum of DNA strand-breaks than do low-LET radiations, can induce the repair mechanism. The experiments will also help to determine whether or not there is an LET dependence on the induction of adaptation that is dependent upon microdosimetric considerations.

DOE-163 Deposition of Radon and Radon Progeny in the Respiratory Tract

* Type of Activity:	Basic research
* Primary Funding Agency:	DOE Office of Energy Research
* Other Funding Agency:	None
* Funding for FY 88:	$200,000
* Status:	New

* Principal Contact: Hsu-Chi Yeh
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* Activity Description:

1. Research objectives - The goal of this research is to determine the deposition sites of inhaled radon progeny in the respiratory tract of people and to quantify fractional deposition at these sites for different modes of breathing, body sizes, and aerosol characteristics.

2. Relevance to radon issue - This information is essential for calculating radiation doses to cells at risk in specific airway segments for people exposed under different conditions. Having such capability, it will be possible to (1) calculate radiation doses to adult male miners who inhaled aerosols of radon progeny from the air of underground uranium mines, (2) calculate radiation doses to the respiratory airways of male and female children and adults who inhale aerosols of radon progeny in homes and other buildings, and (3) compare the relative distributions of radiation dose to the respiratory tract tissues and the exposure-dose relationships for uranium miners with those for general population. These comparisons will help determine how exposure- dose-effect relationships developed from epidemiological studies of uranium miners can be applied in evaluating lung cancer risk to people from inhaling radon progeny indoors.

OFFICE OF DEFENSE PROGRAMS

DEPARTMENT OF ENERGY

DOE-164 K-65 Silo Interim Stabilization and Remediation

* Type of Activity:	Operational program
* Primary Funding Agency:	DOE Defense Programs
* Other Funding Agency:	None
* Funding for FY 88:	$2,400,000
* Status:	Ongoing
* Principal Contact:	Westinghouse Materials Company of Ohio 7400 Wiley Road Fernald, Ohio 45030
* Other Contact:	A.F. Kluk U.S. Department of Energy M.S. DP-124 Washington, D.C. 20545 (301) 353-4971

* Activity Description:

1. Research objectives - The objective of this operational activity is to improve the structural stability of the two silos containing K-65 pitchblende residues domes and achieve alteration of the radon emanation. An integral part is the construction of a radon treatment system, using a desiccant and activated charcoal to absorb accumulated quantities of radon in each silo. To support the requirements of a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS) the contents of the silos will be sampled. Analytical data are needed to support risk assessment and scoping of the remedial alternatives.

2. Relevance to radon issue - This project is aimed at determining useful mitigation techniques.

DOE-165 New Brunswick Laboratory Site Decommissioning Project

* Type of Activity:	Operational program
* Primary Funding Agency:	DOE Defense Programs
* Other Funding Agency:	None
* Funding for FY 88:	$100,000
* Status:	Ongoing
* Principal Contact:	Bob Wynveln Argonne National Laboratory 9700 South Cass Avenue Argonne, Illinois 60439
* Other Contact:	A.F. Kluk U.S. Department of Energy M.S. DP-124 Washington, D.C. 20545 (301) 353-4971

* Activity Description:

1. Research objectives - To remove pitchblende contaminated soil from a 5 acre site in New Brunswick, N.J. and to permit return of the site to the public domain through the General Services Administration.

2. Relevance to radon issue - These activities will prevent exposure to the minor amount of radon generated by the contaminated soil.

DEPARTMENT OF ENERGY

DOE-166 Grand Junction Project Office Remedial Action Project

* Type of Activity:	Operational program
* Primary Funding Agency:	DOE Defense Programs
* Other Funding Agency:	None
* Funding for FY 88:	$4,555
* Status:	New
* Principal Contact:	UNC Geotech, Inc. Nick Abramiuk 2594B 314 Road P.O. Box 14000 Grand Junction, Colorado 81502
* Other Contact:	A.F. Kluk U.S. Department of Energy M.S. DP-124 Washington, D.C. 20545 (301) 353-4971

* Activity Description:

1. Research objectives - To remove uranium contaminated soil and permit unrestricted use of site from radiobiological standpoint. Contaminated soil (100,000 cubic yards) is being transported to the Channey reservoir and disposal site and this soil is being replaced with clean fill.

2. Relevance to radon issue - This removal will prevent exposure to the minor amount of radon generated by the contaminated soil.

BONNEVILLE POWER ADMINISTRATION

DEPARTMENT OF ENERGY

DOE-167 Residential Weatherization Program

* Type of Activity:	Field study, operational program
* Primary Funding Agency:	Bonneville Power Administration
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	Charles Eastwood Bonneville Power Administration P.O. Box 3621-RMRD Portland, Oregon 97208 (503) 230-4992 FTS 492-4992
* Other Contact:	Phil Thor Bonneville Power Administration (503) 230-4992 FTS 492-4992

* Activity Description:

1. Research objectives - In compliance with the National Environmental Policy Act, Bonneville Power Administration (BPA) is addressing the environmental impacts of regional conservation programs that offer incentives to homeowners for installing measures to conserve energy. BPA has purchased and distributed radon monitors for program participants. As of June 1988 this program has monitored over 29,000 homes in the northwest. BPA publishes a quarterly report, including a map and data listing, of the updated radon monitoring results. At the request of the program participants, BPA has subsidized the installation of proven radon mitigation devices in 75 residences with measured radon levels over 5 pCi/L.

2. Relevance to radon issue - Monitors indoor residential radon levels. Provides information on the impact from weatherization and particular actions homeowners can take to reduce excessive levels.

DOE-168 Radon Mitigation Demonstration

* Type of Activity:	Education, applied research
* Primary Funding Agency:	Bonneville Power Administration
* Other Funding Agency:	EPA
* Funding for FY 88:	Information not available
* Status:	Proposed
* Principal Contact:	Charles Eastwood Bonneville Power Administration P.O. Box 3621-RMRD Portland, Oregon 97208 (503) 230-4992 FTS 492-4992
* Other Contact:	Phil Thor Bonneville Power Administration (503) 230-4992 FTS 492-4992

* Activity Description:

1. Research objectives - The objective of this joint project between BPA and EPA is to provide training for Pacific Northwest contractors in proven radon mitigation techniques. Two homes with excessive radon levels and twenty contractors will be selected. Two teams of ten contractors and an instructor would work in each home for a week diagnosing, installing, and testing a mitigation system. On the last day, both teams would examine the product of the other and discuss results.

2. Relevance to radon issue - This program provides needed experience in radon mitigation services for Pacific Northwest contractors.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

CENTERS FOR DISEASE CONTROL

DEPARTMENT OF HEALTH AND HUMAN SERVICES

HHS-101 Consultations with States and Other Organizations

* Type of Activity:	Operational program, education
* Primary Funding Agency:	Centers for Disease Control
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing

* Principal Contact:

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* Other Contact:

* Activity Description:

1. Research objectives - CDC responds to requests from states on all health aspects of radon exposure. CDC is currently serving on one State radon committee and has more limited contact with many others. CDC is also assisting the American Academy of Pediatrics in formulating recommendations to pediatricians about radon.

2. Relevance to radon issue - CDC is available for consultations with states and other organizations on all health aspects of radon exposure.

HHS-102 Evaluation of Radioactive Waste Sites Under Superfund

* Type of Activity:	Field study
* Primary Funding Agency:	Agency for Toxic Substances & Disease Registry
* Other Funding Agency:	Centers for Disease Control
* Current year funding:	Intramural
* Status:	Ongoing

* Principal Contact:

Christie Eheman
Centers for Disease Control
Division of Environmental Hazards and Health Effects
Koger 2000 F28
1600 Clifton Road, N.E.
Atlanta, Georgia 30333
(404) 488-4682
FTS 236-4682

* Other Contact:

* Activity Description:

1. Research objectives - At the request of the Agency for Toxic Substances and Disease Registry (ATSDR), CDC has evaluated the radiation dose and the subsequent health risk from industrial and residential sites contaminated with radioactive material. Many of these sites involve radon exposure of the public. CDC also assesses the effectiveness of remedial action at these sites.

2. Relevance to radon issue - This project will contribute to the understanding of the health effects resulting from radon exposure and the effectiveness of actions to reduce exposure.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

HHS-103 National Park Service Indoor Radon Program
(Same as DOE-101)

* Type of Activity:	Field study
* Primary Funding Agency:	Department of Interior
* Other Funding Agency:	Centers for Disease Control
* Funding for FY 88:	No special funding from CDC
* Status:	Ongoing
* Principal Contact:	Dan Hoffman, Ph.D. Centers for Disease Control Division of Environmental Hazards and Health Effects Koger 2000 F28 1600 Clifton Road, N.E. Atlanta, Georgia 30333 (404) 488-4772 FTS 236-4772
* Other Contact:	Joe Schock National Park Service Box 37127 Washington, D.C. 20013 (202) 343-7090

* Activity Description:

1. Research objectives - CDC assisted in the design and implementation of the National Park Service indoor radon sampling program. The goal of the program is to identify and remediate buildings with radon levels which exceed remedial action guidelines from CDC and EPA. The initial sampling is complete and mitigation has been completed in some buildings. However, additional follow-up sampling and remedial action are ongoing.

2. Relevance to radon issue - This program will reduce exposures to radon and may help identify effective mitigation techniques.

NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES

DEPARTMENT OF HEALTH AND HUMAN SERVICES

HHS-105 Radon Progeny and Lung Cancer

* Type of Activity:	Epidemiologic study
* Primary Funding Agency:	National Institute of Environmental Health Sciences
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	New
* Principal Contact:	Gwen W. Collman, Ph.D. Epidemiology Branch National Institute of Environmental Health Sciences P.O. Box 12233 Research Triangle Park, North Carolina 27709 (919) 541-4980
* Other Contact:	Dr. Joseph Lyon University of Utah Division of Epidemiology

* Activity Description:

1. Research objectives - We propose to investigate the relationship between indoor radon exposure and lung cancer using 350 non-smoking histologically confirmed lung cancer cases and 700 age/sex/smoking history matched controls selected by random-digit-dialing and HCFA payment rosters. The cases will be identified from new cases of lung cancer reported by the Utah and Idaho Cancer Registries. We propose to obtain a lifetime residential history and to measure indoor radon exposure for each case and control. Odds ratios will be calculated relating radon exposure to lung cancer and will be adjusted for confounding by passive smoking, exposure to other hazardous materials such as asbestos, and use of Vitamin A and it precursors.

2. Relevance to radon issue - This study will provide information to aid in determining the relationship between indoor radon exposure and lung cancer.

HHS-106 Cancer Mortality and Radon-222 Concentration in North Carolina Groundwater

* Type of Activity:	Epidemiological study
* Primary Funding Agency:	National Institute of Environmental Health Sciences
* Other Funding Agency:	None
* Funding for FY 88:	Intramural
* Status:	Final year
* Principal Contact:	Gwen W. Collman, Ph.D. Epidemiology Branch National Institute of Environmental Health Sciences P.O. Box 12233 Research Triangle Park, North Carolina 27709 (919) 541-4980

* Other Contact:

* Activity Description:

1. Research objectives - Cancer mortality rates for selected sites other than the lung in adults were compared in counties in North Carolina with high and low concentrations of radon in groundwater. No statistically significant relationships were found. The results of this study have been accepted for publication in the Archives of Occupational and Environmental Health in 1988.

2. Relevance to radon issue - North Carolina has a gradient of groundwater radon levels due to its diverse geology. The association between these levels and non-lung cancer mortality was examined to see if the small amount of alpha-radiation circulating throughout the body was harmful.

NATIONAL CANCER INSTITUTE

DEPARTMENT OF HEALTH AND HUMAN SERVICES

HHS-107 Lung Cancer Among Nonsmoking Missouri Women With Residential Exposure to Radon

* Type of Activity:	Epidemiology
* Primary Funding Agency:	National Cancer Institute
* Other Funding Agency:	None
* Funding for FY 88:	Intramural
* Status:	Ongoing
* Principal Contact:	Dr. Michael Alavanja, P.H. National Cancer Institute (301) 496-1161
* Other Contact:	Zdenek Hrubec, Sc.D. National Cancer Institute Division of Cancer Etiology (301) 496-6600

* Activity Description:

1. Research objectives - New lung cancer cases identified among nonsmoking women through the Missouri Cancer Registry are being interviewed soon after diagnosis. Controls are being selected from the state driver's license registry (age <65) or from the Health Care Financing Administration files (age ≥65). For each subject, measurements of radon concentrations will be obtained in all the dwellings where the subject resided in the past 30 years. About 1,000 residences will be evaluated. Estimates of lung cancer risk per pCi/l will be compared with corresponding estimates derived from data on miners.

2. Relevance to radon issue - There are almost no data that directly evaluate the risk of lung cancer per pCi/l of household radon concentration. This work will provide such an estimate.

HHS-108 Household Radon Exposure Among Women Admitted to Stockholm Hospitals

* Type of Activity:	Epidemiology
* Primary Funding Agency:	National Cancer Institute
* Other Funding Agency:	None
* Funding for FY 88:	Intramural
* Status:	Ongoing

* Principal Contact:	Zdenek Hrubec, Sc.D. National Cancer Institute Division of Cancer Etiology (301) 496-6600
* Other Contact:	John D. Boice, Jr. National Cancer Institute Division of Cancer Etiology (301) 496-6600

* Activity Description:

1. Research objectives - A radon assessment component has been added to a recently completed comprehensive case-control study of lung cancer among 200 women admitted to hospitals in Stockholm. Two controls have been selected for each case. For each subject, measurements of radon concentrations are being obtained in all the dwellings where the subject resided since 1940. About 1,500 residences are being evaluated. Estimates of lung cancer risk per pCi/l of concentration will be obtained and corrected for important covariables. A comparison with corresponding estimates derived from data on miners will be made.

2. Relevance to radon issue - There are almost no data that directly evaluate the risk of lung cancer per pCi/l of household radon concentration. This work will provide such an estimate.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

HHS-109 Lung Cancer Among Women in Shenyang, China Exposed to Indoor Radon and Other Pollutants

* Type of Activity:	Epidemiology
* Primary Funding Agency:	National Cancer Institute
* Other Funding Agency:	None
* Funding for FY 88:	Intramural
* Status:	Ongoing
* Principal Contact:	John D. Boice, Jr., Sc.D. National Cancer Institute Division of Cancer Etiology (301) 496-6600
* Other Contact:	William J. Blot, Ph.D. National Cancer Institute Division of Cancer Etiology (301) 496-4153

* Activity Description:

1. Research objectives - A radon assessment component has been added to an ongoing comprehensive case-control study of lung cancer among 460 women living in Shenyang, China. One control has been selected for each case. For each subject, measurements of radon concentrations have been obtained in all the dwellings where the subject resided. Estimates of lung cancer risk per pCi/l of concentration will be obtained and corrected for important covariables. Shenyang, one of the most polluted cities in the world, is located in the Liaoning Province, the region with the highest incidence rate of lung cancer in all of China. Advantages of conducting this research in China include the very low mobility of the population such that lifetime exposures to radon can be reasonably estimated.

2. Relevance to radon issue - There are almost no data that directly evaluate the risk of lung cancer per pCi/l of household radon concentration. This work will provide information necessary to assess the possible magnitude of lung cancer risk associated with low-level radon exposure.

HHS-110 Lung Cancer Among Women in New Jersey

* Type of Activity:	Epidemiology
* Primary Funding Agency:	National Cancer Institute
* Other Funding Agency:	None
* Funding for FY 88:	Intramural
* Status:	Ongoing
* Principal Contact:	Zdenek Hrubec, Sc.D. National Cancer Institute Division of Cancer Etiology (301) 496-6600
* Other Contact:	John D. Boice, Jr. National Cancer Institute Division of Cancer Etiology (301) 496-6600

* Activity Description:

1. Research objectives - As part of a case-control study of lung cancer among women in New Jersey, in collaboration with the New Jersey Department of Health, radon is being evaluated as a potential risk factor by monitoring radon levels in the homes of persons who developed lung cancer and in the homes of others who do not have the disease. New Jersey was chosen as the study site largely because many municipalities in this region are located in the Reading Prong, a uranium-rich belt of land extending through Pennsylvania, New Jersey, and New York. To assess cumulative radon exposure of the New Jersey women, two radon detectors in long-term residences of approximately 800 women--400 women who are diagnosed with lung cancer in 1982 and 1983, and 400 controls.

2. Relevance to radon issue - There are almost no data that directly evaluate the risk of lung cancer per pCi/l of household radon concentration. This work will provide data to address this issue. Possible interaction of radon with cigarette smoking will be evaluated.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

HHS-111 Epidemiologic Studies of Lung Cancer and Other Diseases Among Employees of the Yunnan Tin Corporation and Residents of Gejiu City, Peoples Republic of China

* Type of Activity:	Epidemiology
* Primary Funding Agency:	National Cancer Institute
* Other Funding Agency:	None
* Funding for FY 88:	Intramural
* Status:	Ongoing
* Principal Contact:	Jay H. Lubin, Ph.D. National Cancer Institute Division of Cancer Etiology (301) 496-3356
* Other Contact:	William J. Blot, Ph.D. National Cancer Institute Division of Cancer Etiology (301) 496-4153

* Activity Description:

1. Research objectives - This project involves two components, (i) a historical cohort study of employees of a tin company, whose underground workers are exposed to high levels of radon and radon decay products, and (ii) an incident case control study of lung cancer among company employees and residents of Gejiu City. In both components, occupational history has been obtained, as well as information on tobacco use. Mine exposures to radon, arsenic and other contaminants have been estimated using historical measurements and extrapolations based on mine conditions and techniques. For living cases and their controls, estimates of total radon exposure have been obtained by measuring skeletal lead-210, a long-lived decay product of radon and a bone seeker.

2. Relevance to radon issue - The cohort study involves over 22,000 employees and over 1,100 lung cancer deaths, making the study largest of its kind. In both components, the large numbers of workers who were exposed as children or who were exposed for many years provide unique data not available in other studies. These data will provide the most precise evaluation of the radon exposure response relationship, the role of smoking, age, age at first exposure, exposure rate and other factors yet possible.

HUD-102 Assistance in the Development of a National Policy Regarding Radon Exposure

* Type of Activity:	Operational program
* Primary Funding Agency:	CIRRPC
* Other Funding Agency:	None
* Funding for FY 88:	$40,000
* Status:	New
* Principal Contact:	Robin Spradlen Oak Ridge Operations Office
* Other Contact:	James Miller Department of Housing and Urban Development (202) 755-7225

* Activity Description:

1. Research objectives - The objective of this project is to provide scientific and technical analysis of radiation research, including radon gas. A basis for Federal consensus on environmental radon exposure will be developed using data generated by DOE, EPA, and National Academy of Science.

2. Relevance to radon issue - This project will aid in the development of a national policy regarding radon exposure.

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

DEPARTMENT OF THE INTERIOR

DOI-101 Indoor Radon Program
(Same as HHS-103)

* Type of Activity:	Field study, monitoring
* Primary Funding Agency:	National Park Service
* Other Funding Agency:	None
* Funding for FY 88:	$100,000
* Status:	Ongoing
* Principal Contact:	Joe Schock National Park Service Box 37127 Washington, D.C. 20013 (202) 343-7090
* Other Contact:	Allen Kingsbury National Park Service (202) 343-7090

* Activity Description:

1. Research objectives - The objective of this project is to (1) measure radon in all residences and office buildings owned by National Park Service and (2) mitigate buildings to reduce to "safe" levels. Results: of 33,000 buildings, 11% exceed 4pCi/l.

2. Relevance to radon issue - This project will reduce the potential for radon exposure in National Park Service buildings.

DOI-102 Radon Exposure Assessment of National Park Service Employees Who Work in Caves
(Same as HHS-104)

* Type of Activity:	Field study
* Primary Funding Agency:	Centers for Disease Control
* Other Funding Agency:	Department of Interior
* Funding for FY 88:	Intramural
* Status:	Ongoing

* Principal Contact:

Christie Eheman
Centers for Disease Control
Division of Environmental Hazards and Health Effects
Koger 2000 F28
1600 Clifton Road, N.E.
Atlanta, Georgia 30333
(404) 488-4682
FTS 236-4682

* Other Contact:

* Activity Description:

1. Research objectives - CDC has been working with the National Park Service in assessing past and current radon exposure of employees who work in caves. CDC and NPS are interested in practical issues such as reducing exposure of workers to radon as well as the possibility of an epidemiologic study of park service employees exposed to radon at home and in caves.

2. Relevance to radon issue - This information will further the understanding of the health effects related to radon exposure.

U.S. GEOLOGICAL SURVEY

DEPARTMENT OF THE INTERIOR

DOI-103 Gas Transport in Soils and its Relation to Radon Availability
(Same as DOE-152)

* Type of Activity:	Field study, applied research
* Primary Funding Agency:	DOE Office of Health & Environmental Research
* Other Funding Agency:	U.S. Geological Survey
* Funding for FY 88:	$200,000
* Status:	Ongoing

* Principal Contact: Allan B. Tanner
U.S. Geological Survey
990 National Center
Reston, Virginia 22092

* Other Contact: G. Michael Reimer
U.S. Geological Survey

* Activity Description:

1. Research objectives - Field measurements and experiments are being conducted to furnish more quantitative information about the range and variability of soil characteristics that control the diffusion of radon and the flow of radon-bearing soil gas in the horizontal and vertical directions. Sites having different characteristic soil properties and horizontal layering are studied by means of extraction of soil gas or injection of tracer gases through soil probes. Supplementary soil sampling and analysis and meteorological measurements are made.

2. Relevance to radon issue - The concentration of radon in soil gas and the ease of radon movement through soil or fractured rock are two of the critical factors of radon entry into buildings.

DOI-104 Mobility, Transport and Fate of Naturally Occurring Radionuclides in Ground Water Newark Basin, New Jersey

* Type of Activity:	Field study, applied research
* Primary Funding Agency:	USGS Water Resources Division
* Other Funding Agency:	New Jersey Dept. of Environmental Protection, Division of Water Resources
* Funding for FY 88:	$200,000
* Status:	Ongoing
* Principal Contact:	Otto S. Zepecza U.S. Geological Survey Water Resources Division 810 Bear Tavern Road Suite 206 West Trenton, New Jersey 08628 (609) 771-3900
* Other Contact:	Robert Schoen U.S. Geological Survey (703) 648-6871

* Activity Description:

1. Research objectives - The specific objectives of this research are to (1) determine factors controlling radionuclide transport and fate along ground-water flow paths, (2) define mechanisms that release radionuclides to ground water or retain them in aquifer solids, (3) characterize spatial variation of radionuclide concentrations and factors affecting parent/daughter activities and isotope ratios. Observation wells will be installed along selected gradients. Testing drilling will be used to obtain uranium-enriched core. Rock analysis will be used to study the sources/sinks of radium, uranium and radon. Additional experiments will involve rock leaching, radon emanation and bacterial analysis. Detailed ground-water sampling and chemical modeling will be used to define reactions along flow paths.

2. Relevance to radon issue - Elevated levels of naturally occurring radionuclides in ground water are associated with uranium-rich rocks; these rocks are also associated with elevated levels of indoor airborne radon.

DEPARTMENT OF THE INTERIOR

DOI-105 Natural Radioactivity in Ground Water of the Kirkwood-Cohansey Aquifer System, Southern Coastal Plain, New Jersey

* Type of Activity:	Field study, applied research
* Primary Funding Agency:	USGS Water Resources Division
* Other Funding Agency:	New Jersey Department of Environmental Protection, Division of Science and Research
* Funding for FY 88:	$100,000
* Status:	New

* Principal Contact: Otto S. Zepecza
U.S. Geological Survey
Water Resources Division
810 Bear Tavern Road
Suite 206
West Trenton, New Jersey 08628
(609) 771-3900

* Other Contact: Robert Schoen
U.S. Geological Survey
(703) 648-6871

* Activity Description:

1. Research objectives - Specific objectives are to (1) define occurrence and distribution of radionuclides in ground water, (2) identify relation between radionuclide activities and other chemical constituents, (3) attempt to define source of radioactivity to ground water and (4) evaluate changes in ground water chemistry and radionuclide content along flow paths. Fifty wells will be sampled for complete analysis of radiochemical and chemical constituents. Wells be selected based on aerial distribution in their location along ground-water flow paths. Gamma-ray logging and field reconnaissance will be used to locate source material. Isotopic ratios of radium and uranium will be investigated.

2. Relevance to radon issue - Elevated levels of naturally occurring radionuclides in ground water are associated with uranium-rich deposits; these deposits are also associated with elevated levels of indoor airborne radon.

DOI-106 An Investigation of the Geology and Geochemistry of Radon in Shear Zones
(Same as DOE-123)

* Type of Activity:	Field study, basic research
* Primary Funding Agency:	DOE Office of Health & Environmental Research
* Other Funding Agency:	U.S. Geological Survey
* Funding for FY 88:	$157,000
* Status:	New

* Principal Contact:

Linda C.S. Gundersen
U.S. Geological Survey
955 National Center
Reston, Virginia 22092

* Other Contact:

* Activity Description:

1. Research objectives - The production and migration of radon in six major shear zones along the east coast of the U.S. is being investigated by use of modern techniques of geochemistry, structural analysis, pedology (soil science), aqueous chemistry, and gas measurement.

2. Relevance to radon issue - Shear zones have been identified as the major cause of some of the highest indoor radon and radon in water ever noted in the U.S. The results of this study will provide essential data for understanding the processes involved in creating these hazardous zones and knowing where similar occurrences are likely to exist.

DEPARTMENT OF THE INTERIOR

DOI-107 Relationships Between Aeroradiometric Measurements of Bismuth-214 and Soil Radioactivity, Radium, and Radon Content
(Same as DOE-119)

* Type of Activity:	Basic research, field study
* Primary Funding Agency:	DOE Office of Health & Environmental Research
* Other Funding Agency:	U.S. Geological Survey
* Funding for FY 88:	$122,000
* Status:	Ongoing

* Principal Contact: G. Michael Reimer
U.S. Geological Survey
MS 963
P.O. Box 25046
Denver, Colorado 80225

* Other Contact: Joseph S. Duval
U.S. Geological Survey
(703) 648-6391

* Activity Description:

1. Research objectives - The correlation between aeroradiometric surveys using the 1.76-MeV gamma radiation from ^{214}Bi, a radon decay product, and the radium concentration in soil and the radon concentration in soil gas at selected sites beneath flight paths of the National Resource Evaluation program surveys is being investigated. Sites are selected to provide variation in geology. Ground gamma spectrometer and soil-gas measurements are made in the field, and supplemental characterization of soil samples is made in the laboratory.

2. Relevance to radon issue - Aeroradiometric survey data are useful in characterizing the regional level of uranium-series radioactivity in upper 20 to 30 cm of soil. In order to evaluate the survey data properly, possible sources of error due to ground characteristics other than simply the radium concentration in the ground need to be understood.

DOI-108 IAG with USGS: National Equivalent Uranium Map Production
(Same as EPA-113)

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	U.S. Geological Survey
* Funding for FY 88:	$150,000
* Status:	Ongoing
* Principal Contact:	Tom Peake U.S. Environmental Protection Agency ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Joe Duval U.S. Geological Survey FTS 648-6391

* Activity Description:

1. Research objectives - The EPA and the USGS are co-funding the reprocessing of U.S. DOE National Uranium Resource Evaluation (NURE) aerial radiometric data. This data will be published in a map at a 1:2,500,000 scale, the size of the USGS map of the United States. In addition, the USGS will provide 1:1,000,000 scale maps for each EPA region. Preliminary comparisons of regional NURE and indoor radon measurement data suggest that there is a good correlation between the two variables. These maps, depicting areas of high radioactivity, will be used to quantify the radon potential for broad regions of the U.S.

2. Relevance to radon issue - Maps will be published that may help identify areas of high radon potential.

DEPARTMENT OF THE INTERIOR

DOI-109 IAG with USGS: Technical Assistance for State Radon Surveys
(Same as EPA-116)

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$30,000
* Status:	Ongoing
* Principal Contact:	Tom Peake U.S. Environmental Protection Agency 401 M. Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	James K. Otton U.S. Geological Survey FTS 648-6402

* Activity Description:

1. Research objectives - The objective of this research is to provide geological assessments of statewide radon potential for states participating in the State/EPA Indoor Radon Survey program.

2. Relevance to radon issue - Geological characterizations are used in the development of State/EPA Indoor Radon Survey sampling plans. These characterizations identify the radon potential of regions within each participating State and are the first step in the State Survey process.

DEPARTMENT OF LABOR

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

DEPARTMENT OF LABOR

DOL-101 OSHA Guidelines

* Type of Activity:	Guideline development
* Primary Funding Agency:	None
* Other Funding Agency:	None
* Funding for FY 88:	None
* Status:	Ongoing
* Principal Contact:	N/A
* Other Contact:	N/A

* Activity Description:

1. Research objectives - The Occupational Safety and Health Administration (OSHA) is not involved in any radon research activities. OSHA is currently developing guidelines for the evaluation of indoor air quality. It has not yet been determined if radon will be addressed separately or included in the guidelines.

2. Relevance to radon issue - Guidelines for the evaluation of indoor air quality will be developed.

DEPARTMENT OF STATE

DEPARTMENT OF STATE

DOS-101 Radon Assessment Advisory Group

* Type of Activity:	Operational program
* Primary Funding Agency:	Department of State
* Other Funding Agency:	None
* Funding for FY 88:	None
* Status:	Ongoing
* Principal Contact:	Stephen Urman, A/OPR/SAF Department of State 2201 C Street, N.W. Washington, D.C. 20520 (202) 647-4302
* Other Contact:	Rudolph Marrazzo, M/MED/EH Department of State 2201 C Street, N.W. Washington, D.C. 20520 (202) 647-6923

* Activity Description:

1. Research objectives - An Issue/Decision paper on Radon was recently finalized by the Department Radon Assessment Advisory Group (RAAG) and transmitted to the Undersecretary for selection of a course of action on how to deal with the potential health risk to Department employees and dependents in overseas locations. The issue/decision paper contained information and data which the RAAG compiled over the past year from their contact with EPA and other Federal Agencies along with recognized professional technical and scientific groups. It was recommended that the Undersecretary authorize the development and implementation of a Radon Assessment and Mitigation Program (RAMP) and require the RAAG to develop an action plan with estimated resources required for a 3 to 5 year period. It is expected that this strategy will be timely in addressing Federal agency mandates contained in recently passed legislation on Radon control in government properties which may impact on the Department.

2. Relevance to radon issue - It is expected that the Department will have a definite course of action selected by the end of FY 1988 regarding a Radon control program for overseas building and dwellings.

ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF DRINKING WATER

ENVIRONMENTAL PROTECTION AGENCY

EPA-101 Regulatory Proposal for Radionuclides in Drinking Water

* Type of Activity:	Applied research, operational program
* Primary Funding Agency:	EPA Office of Drinking Water
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	New

* Principal Contact: Irwin Pomerantz
U.S. Environmental Protection Agency
Office of Drinking Water
401 M Street, S.W.
WH-550D
Washington, D.C. 20460
(202) 382-3026

* Other Contact: M.B. Cook
U.S. Environmental Protection Agency

* Activity Description:

1. Research objectives - Research studies being carried out address analytical measurement of certain radionuclides, collection of occurrence data and development of water treatment data for removal of radionuclides from drinking water--all in support of regulation development. It is intended that radon levels in drinking water will be regulated (public water supplies). Radon in drinking water has not previously been regulated in U.S. The concern derives from contribution of radon in water to the indoor air.

2. Relevance to radon issue - Reducing levels of radon in drinking water would reduce the potential for radon exposure.

EPA-102 Radon Removal Techniques for Community Water Supplier in New Hampshire

* Type of Activity:	Field Study
* Primary Funding Agency:	EPA
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing

* Principal Contact:

Kim R. Fox
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460
FTS 684-7820

* Other Contact:

* Activity Description:

1. Research objectives - Granular activated carbon and aeration pilot plant system will be used on community water supplies to determine the effectiveness of each system to remove radon from drinking water.

2. Relevance to radon issue - Data on radon removal is needed to assist communities in removing radon from drinking water.

ENVIRONMENTAL PROTECTION AGENCY

EPA-103 Report on Radon Removal from Drinking Water

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	New

* Principal Contact: Kim R. Fox
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460
FTS 684-7820

* Other Contact:

* Activity Description:

1. Research objectives - The purpose of this project is to prepare a report based on the historical records on the designing, operation, and cost associated with the GAC point of entry systems. The contractor, Lowry Engineering, has been collecting data on these systems for eight years and will have most of the requested information in historical records.

2. Relevance to radon issue - There is a lack of data concerning long term removal of radon from drinking water. This data is needed to support the proposed radon regulations. The data from this report will also be used to revise the EPA brochure "Removal of Radon from Household Water" and its companion document "Radon Removal from Drinking Water Using Home Treatment Systems--A Guidance Manual".

OFFICE OF RADIATION PROGRAMS

ENVIRONMENTAL PROTECTION AGENCY

EPA-104 Radon Education and Awareness for Health Workers

* Type of Activity:	Education
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	AMA
* Funding for FY 88:	$40,000 (EPA)
* Status:	New
* Principal Contact:	Mary Beth Tuohy U.S. Environmental Protection Agency 401 M Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605
* Other Contact:	American Medical Association 535 N. Dearborn Street Chicago, Illinois 60610

* Activity Description:

1. Research objectives - The American Medical Association (AMA) has a Cooperative Agreement with EPA to inform health professionals about the risks associated with indoor radon. Increased awareness among health workers will prepare them to respond to questions by patients and others about radon and the risks it poses.

2. Relevance to radon issue - The agreement provides for AMA to plan and carry out six regional conferences by October 1989. The AMA will also prepare a brochure on radon and its risks that is suitable for distribution to health professionals. In addition, the AMA staff will assist EPA in preparing an educational video for health professionals on the radon problem.

EPA-105 Building Site Characterization

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$150,000
* Status:	Ongoing

* Principal Contact: Tom Peake
U.S. Environmental Protection Agency
ANR-464
Washington, D.C. 20460
(202) 475-9605
FTS 475-9605

* Other Contact: Kirk Maconaughey
U.S. Environmental Protection Agency
(202) 475-9605
FTS 475-9605

* Activity Description:

1. Research objectives - The objective of this research is to investigate the use of radon in soil gas and other methods to characterize the radon potential of building sites. The approach used involves the development of soil gas measurement methodology (with the USGS and a contractor) the development of a method to calibrate soil permeability measurement devices, conducting radioactivity measurements around existing homes, and conducting measurements at undeveloped sites. These projects are part of ORP's Land Evaluation Studies and New House Evaluation Program. Site characterization assistance has also been provided to EPA's Office of Research and Development.

2. Relevance to radon issue - This project will assist in the development of land evaluation criteria as well as investigate the effectiveness of radon prevention construction.

ENVIRONMENTAL PROTECTION AGENCY

EPA-106 Butte, Montana Radon Report

* Type of Activity:	Field study
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$5,000
* Status:	Ongoing
* Principal Contact:	Melinda Ronca-Battista U.S. Environmental Protection Agency 401 M Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605
* Other Contact:	Kirk Maconaughey U.S. Environmental Protection Agency (202) 475-9605 FTS 475-9605

* Activity Description:

1. Research objectives - In this report, the results of extensive measurements made by EPA and the Montana Department of Health and Environmental Sciences in 68 homes in Butte, Montana are being summarized. The report will include a description of the quality assurance methods and major conclusions of the study.

2. Relevance to radon issue - This report will provide a large database of radon and radon decay product measurements over an 18-month period in 68 occupied homes, allowing analyses of measurement reproducibility and method intercomparisons.

EPA-107 Comparison of Geology and Indoor Radon

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	Intramural
* Status:	Ongoing
* Principal Contact:	Tom Peake U.S. Environmental Protection Agency 401 M Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Kirk Maconaughey U.S. Environmental Protection Agency (202) 475-9605 FTS 475-9605

* Activity Description:

1. Research objectives - The objectives of this project are to develop methodology to identify high radon potential areas and to direct Contractors in the mapping of high radon potential areas. The effort involves using data from State/EPA Indoor Radon Surveys and commercial radon measurement data as well as geological information obtained from the USGS, USDOE, and the Soil Conservation Service (USDA).

2. Relevance to radon issue - The methodology being developed is currently used to develop geological characterization for State surveys.

ENVIRONMENTAL PROTECTION AGENCY

EPA-108 Interagency Committee on Indoor Air Quality and Radon Workgroup

* Type of Activity:	Operational program
* Primary Funding Agency:	EPA/DOE
* Other Funding Agency:	Department of Energy
* Funding for FY 88:	$36,744
* Status:	Ongoing

* Principal Contact: Margo Ogé
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Susan Rose
Radon Program Manager
U.S. Department of Energy
(301) 353-5355

* Other Contact: Marjorie Norman
ICF/Clement Associates, Inc.
(703) 934-3000 or 3127

* Activity Description:

1. Research objectives - ORP/RD participates in the Interagency Committee on Indoor Air Quality (CIAQ). Radon Division staff regularly provide updates to the CIAQ on pending federal radon legislation, ongoing programs, and topics of interest to the Committee members.

2. Relevance to radon issue - ORP/RD and the Department of Energy co-chair the Radon Workgroup of the CIAQ. The Workgroup provides a forum for Federal agencies to share information on radon and to coordinate Federal research and operational programs. The Workgroup will compile and publish a Federal Radon Project Inventory which will detail the radon activities and research of all Federal agencies.

EPA-109 EPA 1988 Update and Revision of "Reducing Radon in Structures" - Training Course

* Type of Activity: Training
* Primary Funding Agency: EPA Office of Radiation Programs
* Other Funding Agency: None
* Funding for FY 88: $46,000
* Status: New

* Principal Contact:

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New York State Energy Office
SCSC, Alexandria, Virginia

* Other Contact:

* Activity Description:

1. Research objectives - This work will expand the EPA Training Course for radon diagnosticians and mitigators making it more national in scope. In addition, revisions will include current research and survey results which have greatly increased the present body of knowledge relating to radon. Changes will include new text and illustration in the manual, new slides and visual aids.

2. Relevance to radon issue - The pre-existing training materials were not up to date with current mitigation practice, and did not address regional problems that have arisen in the past few years. The planned revision will represent the latest state of radon knowledge.

ENVIRONMENTAL PROTECTION AGENCY

EPA-110 House Evaluation Program

* Type of Activity:	Field study, operational program
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$335,000
* Status:	Ongoing
* Principal Contact:	Gene Fisher U.S. Environmental Protection Agency 401 M Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605
* Other Contact:	Mike Mardis U.S. Environmental Protection Agency (202) 475-9605

* Activity Description:

1. Research objectives - The primary objectives of the House Evaluation Programs are to evaluate the cost and effectiveness of mitigation methods and provide hands on training for state and private sector personnel in diagnosing and mitigating radon problems in houses. States select houses with elevated radon levels for participation and contact homeowners. EPA and state personnel diagnose the source(s) of the radon problem and offer the homeowner alternative mitigation schemes. The homeowner then chooses the mitigation schemes to be used and hires the contractor. After mitigation activities are completed, EPA conducts a post mitigation evaluation to determine the cost and effectiveness of the mitigation efforts. Eleven States will be involved in 1988.

2. Relevance to radon issue - Information gained through testing radon mitigation in real life conditions will be distributed to the public for their use. State and contractor personnel may take the training they receive through the House Evaluation Program and apply it to reducing radon levels in other situations.

EPA-111 Housing Industry Educational Resource on Radon in Homes

* Type of Activity:	Field study, operational program, education
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$150,000
* Status:	Ongoing

* Principal Contact: Dave Murane
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* Other Contact: John Spears
National Association of Homebuilders
National Research Center
(301) 249-4000

* Activity Description:

1. Research objectives - This grant program is structured to educate the building industry on state-of-the-art radon mitigation and prevention techniques. The National Association of Homebuilders - National Research Center (NAHB-NRC) provides an essential interface between EPA and the building industry. NAHB-NRC's ongoing radon information activities include a radon information clearinghouse, a building industry radon hotline, and presentation of radon seminars to builders. New program initiatives for this year include establishment of a tracking system on building industry experience in radon resistant new construction and development of draft building codes to support building code development.

2. Relevance to radon issue - The ultimate objective of this program is to reduce public exposure to radon by retrofitting existing homes and building new homes that are radon resistant. The NAHB-NRC provides an essential interface between EPA and the building industry to achieve that objective.

ENVIRONMENTAL PROTECTION AGENCY

EPA-112 IAG with USGS: Land Evaluation Studies - Coastal Plain Characterization

* Type of Activity:	Field study, applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	U.S. Geological Survey
* Funding for FY 88:	$40,000
* Status:	Ongoing
* Principal Contact:	Tom Peake U.S. Environmental Protection Agency ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Linda Gundersen U.S. Geological Survey FTS 648-6427

* Activity Description:

1. Research objectives - This project will assist EPA in determining the geological characteristics of a low radon potential area. Radioactivity measurements, including radon in soil gas, will be collected in most of the Coastal Plain States between New Jersey and Texas.

2. Relevance to radon issue - This study will produce data that can serve as a reference for a low radon potential region, and to which the radon potential of other areas can be compared. The data will be compared with indoor radon data that is available for the region. Future investigations will determine the geologic characteristics of high radon potential regions. A final report will be available in 1989.

EPA-113 IAG with USGS: National Equivalent Uranium Map Production
(Same as DOI-108)

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	U.S. Geological Survey
* Funding for FY 88:	$150,000
* Status:	Ongoing
* Principal Contact:	Tom Peake U.S. Environmental Protection Agency ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Joe Duval U.S. Geological Survey FTS 648-6391

* Activity Description:

1. Research objectives - The EPA and the USGS are co-funding the reprocessing of U.S. DOE National Uranium Resource Evaluation (NURE) aerial radiometric data. This data will be published in a map at a 1:2,500,000 scale, the size of the USGS map of the United States. In addition, the USGS will provide 1:1,000,000 scale maps for each EPA region. Preliminary comparisons of regional NURE and indoor radon measurement data suggest that there is a good correlation between the two variables. These maps, depicting areas of high radioactivity, will be used to quantify the radon potential for broad regions of the U.S.

2. Relevance to radon issue - Maps will be published that may help identify areas of high radon potential.

ENVIRONMENTAL PROTECTION AGENCY

EPA-114 IAG with DOE: Technical Assistance for Indoor Radon

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$100,000
* Status:	Final year

* Principal Contact:	Tom Peake U.S. Environmental Protection Agency 401 M Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Richard Sextro U.S. Department of Energy Lawrence Berkley Laboratory (415) 486-6591

* Activity Description:

1. Research objectives - Lawrence Berkley Laboratory (LBL) is tasked to deliver a national surface radium map and report using National Uranium Resource Evaluation (NURE) summary statistics; recommendations for radon availability measurements; and a report on standardizing short-term radon sampling using blower door testing.

2. Relevance to radon issue - This project will improve our understanding of radon hazards at a regional and local level. The short-term radon sampling investigation may also have application for real estate transactions. The LBL NURE map will be used as quality control on the more detailed NURE map being prepared by the U.S. Geological Survey.

EPA-115 IAG with DOE: Technical Support of EPA Radon Programs

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$25,000
* Status:	Ongoing
* Principal Contact:	Tom Peake U.S. Environmental Protection Agency 401 M Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Lawrence Ball U.S. Department of Energy FTS 322-9228

* Activity Description:

1. Research objectives - This project consists of mapping the radon potential of EPA Regions III and IV. The final project will consist of booklets that States and EPA Regional Offices can use to identify high radon risk areas within their jurisdictions. This project is a demonstration project and may be continued in other EPA regions. A past project included development of the U.S. map of "Areas With Potentially High Radon Levels" which may be updated in the future.

2. Relevance to radon issue - Booklets that can be used to identify high radon risk areas within EPA Regions III and IV will be developed.

ENVIRONMENTAL PROTECTION AGENCY

EPA-116 IAG with USGS: Technical Assistance for State Radon Surveys
(Same as DOI-109)

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$30,000
* Status:	Ongoing
* Principal Contact:	Tom Peake U.S. Environmental Protection Agency 401 M. Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	James K. Otton U.S. Geological Survey FTS 648-6402

* Activity Description:

1. Research objectives - The objective of this research is to provide geological assessments of statewide radon potential for states participating in the State/EPA Indoor Radon Survey program.

2. Relevance to radon issue - Geological characterizations are used in the development of State/EPA Indoor Radon Survey sampling plans. These characterizations identify the radon potential of regions within each participating State and are the first step in the State Survey process.

EPA-117 National Conference of State Legislatures Cooperative Agreement State Radon Programs: Legislative Options

* Type of Activity:	Education, operational program
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$30,639
* Status:	New

* Principal Contact:

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* Other Contact:

Larry Morandi
National Conference of State Legislatures

* Activity Description:

1. Research objectives - The objective of this program is to provide educational material on the nature of the radon problem and the policy options available to State legislators. The project builds on the work completed by the National Conference of State Legislatures (NCSL) under a previous cooperative agreement with EPA by using the information to conduct two regional radon workshops for legislators and a concurrent session at NCSL's annual meeting.

2. Relevance to radon issue - The project will assist States as they develop radon programs and activities by creating forums for information exchange between Federal officials, State officials and State legislators.

ENVIRONMENTAL PROTECTION AGENCY

EPA-118 National Assessment of Radon Gas (SARA section 118(k))

* Type of Activity:	Operational program, field study, education
* Primary Funding Agency:	EPA
* Other Funding Agency:	None
* Funding for FY 88:	$33,750
* Status:	Ongoing
* Principal Contact:	Jacolyn Dziuban U.S. Environmental Protection Agency 401 M. Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Sandy Cohen & Associates 8200 Riding Ridge Place McLean, Virginia 22012

* Activity Description:

1. Research objectives - The objective of the program is to prepare a report to the Congress that will, to the extent possible, (a) describe locations in the U.S. where radon is found in structures where people live, work, or in schools; (b) assess the level present in these structures; (c) determine the level of radon gas and radon daughters which poses a health threat, and assess the health threat for structures identified in (a); (d) determine methods of reducing or eliminating the human health threat of radon gas and radon daughters; and (e) include guidance and public information materials on the findings or research of mitigating radon.

2. Relevance to radon issue - This report will provide current information on the status of radon activities within the EPA.

EPA-119 National Database of Indoor Radon Measurements

* Type of Activity:	Operational program, field study
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$20,000
* Status:	New

* Principal Contact: Mark Dickson
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* Other Contact: Dave Norwood
U.S. Environmental Protection Agency
Eastern Environmental Radiation Facility
Montgomery, Alabama
(205) 272-3403

* Activity Description:

1. Research objectives - The objective of this project is to prepare a database in the 1988 GAO report on the Federal response to indoor radon problems which recommended that EPA compile a comprehensive database of indoor radon measurements which have been made by private vendors. This database will contain measurements from State/EPA Surveys and Federal facilities, as well as private vendors.

2. Relevance to radon issue - Collecting this data will help the Agency evaluate and compare radon levels in different types of buildings as well as determine which areas of the country have particularly acute radon problems.

ENVIRONMENTAL PROTECTION AGENCY

EPA-120 National Residential Radon Survey

* Type of Activity:	Field study
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$1,200,000
* Status:	Ongoing
* Principal Contact:	Melinda Ronca-Battista U.S. Environmental Protection Agency 401 M Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Kirk Maconaughey U.S. Environmental Protection Agency (202) 475-9605 FTS 475-9605

* Activity Description:

1. Research objectives - The primary objectives of this survey are to (1) estimate the frequency distribution of annual average radon exposures in U.S. homes using year-long measurements, and (2) assess correlations between residential radon concentrations and various factors, such as house construction, heating, and ventilation types.

2. Relevance to radon issue - This survey will provide estimates of national and regional residential radon exposure patterns, allowing the valid estimation of health risks and an accurate assessment of the magnitude of the health threat due to radon exposures in U.S. homes.

EPA-121 New House Evaluation Program (New HEP)

* Type of Activity:	Field study, operational program
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$25,000
* Status:	Ongoing
* Principal Contact:	Dave Murane U.S. Environmental Protection Agency 401 M. Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Tom Peake U.S. Environmental Protection Agency (202) 475-9605 FTS 475-9605

* Activity Description:

1. Research objectives - The New HEP is designed to transfer technology for constructing radon resistant buildings to private sector and provide data for the development of model building codes. EPA will also use New HEP data to validate and update the techniques outlined in EPA's pamphlet "Radon Reduction in New Construction, An Interim Guide". Pre-Construction soil gas measurements and post-construction indoor radon measurements are taken for homes in which radon resistant construction techniques are used. These measurements are used to evaluate the effectiveness of radon reduction techniques and to provide information on the utility of soil gas measurements as predictors of indoor radon levels.

2. Relevance to radon issue - This program identifies construction techniques that consistently prove successful in preventing radon entry into new homes and provides the building industry with guidelines for evaluating the indoor radon potential of prospective building sites.

ENVIRONMENTAL PROTECTION AGENCY

EPA-122 Radon Measurement Proficiency Program (RMP)

* Type of Activity:	Operational program
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$60,000
* Status:	Ongoing
* Principal Contact:	Joe Gearo U.S. Environmental Protection Agency 401 M Street, S.W. ANS-464 Washington, D.C. 20460 (202) 475-9605
* Other Contact:	Mike Smith U.S. Environmental Protection Agency (202) 272-3402

* Activity Description:

1. Research objectives - The National RMP program is designed to test the capabilities of companies measuring indoor radon and provide the public with a mechanism for identifying qualified radon testing companies. Companies which meet RMP proficiency requirements and follow EPA standard measurement protocols are deemed proficient. Proficient companies are then listed in a Cumulative Proficiency Report which is made available to the public by all 50 States. The National RMP is not a Federal certification program. Rather, it provides companies with an opportunity to calibrate and compare their results. It also serves as a core program around which States may develop their own radon testing certification programs.

2. Relevance to radon issue - Companies use the RMP to determine the accuracy of their testing and analysis procedures, while states and consumers may use the RMP to aid them in identifying competent testing firms.

EPA-123 Radon Measurement Videotape

* Type of Activity:	Education
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$32,000
* Status:	New
* Principal Contact:	Jed Harrison U.S. Environmental Protection Agency 401 M. Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	SCSC Alexandria, Virginia

* Activity Description:

1. Research objectives - The video will demonstrate the different types of measurement devices and measurement types (e.g., screening and follow-up) according to EPA protocols. Typical field situations will be used to illustrate each demonstration. The video will familiarize radon diagnosticians and mitigators with measurement technology and protocols.

2. Relevance to radon issue - The video will fulfill the need for visually demonstrating measurement applications which cannot be done in a classroom setting. The video will assist in the development of radon measurement capability at the State level.

ENVIRONMENTAL PROTECTION AGENCY

EPA-124 Radon Measurements in Schools

* Type of Activity:	Field study, applied research
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$100,000
* Status:	Ongoing

* Principal Contact:	Tom Peake U.S. Environmental Protection Agency 401 M. Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Kirk Maconaughey U.S. Environmental Protection Agency (202) 475-9605 FTS 475-9605

* Activity Description:

1. Research objectives - Data are being collected on radon and radon progeny concentrations in schools. One study in Fairfax County, Virginia has been completed and an interim report is expected in August 1988. The study will continue during the 1988-1989 school year.

2. Relevance to radon issue - Data are also being acquired from States and schools systems that have conducted independent measurements. These data will be used to develop interim guidance for radon measurements in schools in the fall of 1988. A final guidance document is expected to be completed in FY 89.

EPA-125 Radon Mitigation and Prevention in Schools and Workplaces

* Type of Activity:	Field study, education
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$50,000
* Status:	New
* Principal Contact:	Dave Murane U.S. Environmental Protection Agency 401 M. Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	John McWaters Sandy Cohen and Associates McLean, Virginia

* Activity Description:

1. Research objectives - This EPA project is designed to transfer information developed by EPA concerning radon mitigation and prevention in larger buildings to the States and private sector. This technology transfer is accomplished through EPA contractors who perform radon entry diagnostics and develop mitigation design plans in pilot buildings. Additional transfer is achieved because maintenance staff or private contractors implement the mitigation designs.

2. Relevance to radon issue - There is a need to expand our knowledge of how to deal with different types of buildings such as schools and workplaces.

ENVIRONMENTAL PROTECTION AGENCY

EPA-126 "Reducing Radon in Structures" Training Course

* Type of Activity:	Training
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$122,000
* Status:	Ongoing

* Principal Contact:

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* Other Contact:

* Activity Description:

1. Research objectives - The "Reducing Radon in Structures" training course for radon diagnostics and mitigation will be delivered nine times in FY 88. The three day workshops will be presented in eight EPA regions to state and local government officials and private sector individuals.

2. Relevance to radon issue - The course is designed to develop capability at the state level with regard to radon measurement, building diagnosis, and mitigation design and installation.

EPA-127 Revisions to EPA Radon Measurement Protocols

* Type of Activity:	Education, operational program
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$10,000
* Status:	New, Final year
* Principal Contact:	Melinda Ronca-Battista U.S. Environmental Protection Agency 401 M Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605
* Other Contact:	Kirk Maconaughey U.S. Environmental Protection Agency (202) 475-9605 FTS 475-9605

* Activity Description:

1. Research objectives - The EPA Radon Measurement Protocols are being revised to include new methods for measuring indoor concentrations of radon and radon decay products.

2. Relevance to radon issue - These protocols will foster consistency in the application of new measurement techniques.

ENVIRONMENTAL PROTECTION AGENCY

EPA-128 State/EPA Indoor Radon Survey

* Type of Activity:	Field study
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$450,000
* Status:	Ongoing
* Principal Contact:	Jacolyn Dziuban U.S. Environmental Protection Agency 401 M Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605
* Other Contact:	Research Triangle Institute Center for Research in Statistics P.O. Box 12194 Research Triangle Park, North Carolina 27709

* Activity Description:

1. Research objectives - The State survey program is designed to help interested States identify specific areas where significantly elevated radon levels (hot spots) may occur, and to estimate the Statewide and regional frequency distribution of screening measurement results. A second objective is to estimate the relationship between short-term screening measurements and annual measurements.

2. Relevance to radon issue - Screening measurements will be made using EPA-supplied and EPA-analyzed charcoal canisters, deployed in the lowest livable area of the home during closed-house conditions. Such screening measurements identify the maximum potential exposure that could occur in that house. Annual measurements are made with an alpha-track detector, deployed for a 12-month period. The purpose of the annual average measurement is to estimate average annual radon exposure. Up to 3,000 residences in each state are measured. In this program, a subset of up to 10% of participating households in each State will receive both a charcoal canister and as many as four alpha track detectors.

EPA-129 State Mitigation Contractor Survey

* Type of Activity:	Field study, operational program
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$50,000
* Status:	New
* Principal Contact:	John Hoornbeck, Dave Murane U.S. Environmental Protection Agency 401 M. Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Sandy Cohen and Associates 8200 Riding Ridge Place McLean, Virginia 22012

* Activity Description:

1. Research objectives - There are three objectives to this effort: (1) collect information on the size and nature of the radon mitigation and prevention industry, (2) obtain information on the effectiveness of specific radon mitigation and prevention techniques and, (3) obtain information on the overall effectiveness of private sector efforts to reduce radon levels. Information will be obtained through a survey of private sector mitigation and prevention firms. The information will aid EPA in providing guidance to States on the development of Radon mitigation certification programs, updating guidances on radon mitigation and prevention techniques, and developing estimates of the level of risk reduction achieved through private sector efforts.

2. Relevance to radon issue - Because EPA's Radon Action Program (RAP) provides information to States and the private sector concerning the radon problem and its correction, it is important for EPA to be knowledgeable about the state of the mitigation industry. In addition, this effort should provide some insight in our progress in addressing the radon problem nationwide.

ENVIRONMENTAL PROTECTION AGENCY

EPA-130 Superfund Cooperative Project

* Type of Activity:	Field study, operational program
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$200,000
* Status:	Ongoing

* Principal Contact:

Gene Fisher
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(202) 475-9605

* Other Contact:

* Activity Description:

1. Research objectives - The purpose of this project is to apply existing mitigation techniques to Superfund sites with high levels of radon in order to reduce human health risks in these areas. The project allows EPA to develop both a standing capability to respond to high risk radon problems at Superfund sites and additional information on diagnosis and mitigation activities in different types of housing. House diagnostics and treatability studies as well as actual mitigation and follow-up activities will be conducted at homes in and around Superfund sites in Montclair, New Jersey and Otawah, Illinois.

2. Relevance to radon issue - This project will allow EPA to gain experience in addressing man-made radon problems in Superfund sites and transfer this experience to private contractors. It will also allow for the development of an ongoing capability to deal with radon problems in Superfund sites.

EPA-131 Teacher Training Workshop for EPA Radon Diagnostician--A Mitigation Training Course

* Type of Activity:	Education
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$73,700
* Status:	Ongoing
* Principal Contact:	SCSC Alexandria, VA
* Other Contact:	Jed Harrison U.S. Environmental Protection Agency Office of Radiation Programs (202) 475-9605

* Activity Description:

1. Research objectives - Twenty individuals with backgrounds in radon-related disciplines will be trained as instructors for the EPA "Reducing Radon in Structures" course. The workshop will familiarize them with the EPA course materials as well as provide specialized instruction in effective teaching methods. The 20 trainees will meet for 5 days of intensive training with present instructors and education specialists.

2. Relevance to radon issue - The workshop is designed to help satisfy the demand for radon training throughout the country by making available a pool of teachers with expertise in radon subject areas and who are trained to teach the EPA course.

ENVIRONMENTAL PROTECTION AGENCY

EPA-132 Workplace Protocol Development and Survey

* Type of Activity:	Field study, operational program
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$75,000
* Status:	New
* Principal Contact:	Lisa Feldt U.S. Environmental Protection Agency 401 M. Street, S.W. ANR-464 Washington, D.C. 20460 (202) 475-9605 FTS 475-9605
* Other Contact:	Sandy Cohen & Associates 8200 Riding Ridge Place McLean, VA 22012

* Activity Description:

1. Research objectives - This project involves developing national protocols for measuring radon in workplaces and conducting a national survey of radon in workplaces. Section 118(k) of the Superfund Amendments and Reauthorization Act (SARA) of 1986 directs EPA to "identify locations and levels of radon gas where people work." A component of this effort is to work with other Federal agencies conducting radon-related studies. Dependant on specific agency needs, EPA's efforts will range from monitoring to directing the participating agency's radon program.

2. Relevance to radon issue - The project will result in the development of workplace measurement protocols to be used throughout the public and private sectors for radon testing. The project will help identify and quantify public health risks posed by radon in the work environment.

EPA-133 New House Evaluation Protocol Project

* Type of Activity:	Field study
* Primary Funding Agency:	EPA Office of Radiation Programs
* Other Funding Agency:	None
* Funding for FY 88:	$25,000
* Status:	Ongoing
* Principal Contact:	Dave Murane U.S. Environmental Protection Agency Radon Division 401 M Street, S.W. Washington, D.C. 20460 (202) 475-9605
* Other Contact:	Sandy Cohen & Associates 8200 Riding Ridge Place McLean, VA 22012 (202) 475-9605

* Activity Description:

1. Research objectives - Through this project, EPA is developing protocols for evaluating the effectiveness of specific construction techniques in preventing radon entry into new homes. EPA will use these protocols to aid in evaluating private sector radon prevention activities. The protocols will also be sent to appropriate standards organizations for consideration as industry standards.

2. Relevance to radon issue - The project will result in the development of workplace measurement protocols to be used throughout the public and private sectors for radon testing. The project will help identify and quantify public health risks posed by radon in the work environment.

OFFICE OF RESEARCH AND DEVELOPMENT

ENVIRONMENTAL PROTECTION AGENCY

EPA-134 Expert System for Radon Reduction

* Type of Activity:	Applied research
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - A first attempt to develop an expert system to select a method of mitigation was employed during 1987. This initial model with significant improvements will constitute one of four basic modules that will make up the radon reduction expert system.

2. Relevance to radon issue - The system will be valuable to disseminate information on radon mitigation techniques to users at various levels.

EPA-135 Radon Mitigation Development and Demonstration Program - Florida Existing Home Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - The objective of this project is the development of designs for radon mitigation in slab-on-grade houses representative of the housing stock located in Central Florida. Criteria will be developed specific to this type of house construction and geologic soil conditions. This study will determine which mitigation systems will most likely be successful in the region.

2. Relevance to radon issue - This program will research, develop, and demonstrate cost-effective radon mitigation techniques applicable to homeowners.

ENVIRONMENTAL PROTECTION AGENCY

EPA-136 Radon Mitigation Development and Demonstration Program - New Jersey Existing Home Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	DOE New Jersey Department of Environmental Protection
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - This detailed diagnostic study of fourteen houses will try to extend the current understanding of the fundamental processes of radon transport, entry and distribution in houses. Other objectives of the study are to provide diagnostic procedures that can be used in specifying appropriate and effective mitigation measures and provide field evaluation and refinement of interim diagnostic analysis protocols. These data are currently undergoing detailed analysis through statistical and physical modeling. It is anticipated that the analysis and models will result in increased cost-effectiveness of subsequent radon mitigation. As follow-up to this project Princeton University will be conducting a study focusing on the optimization of ventilation techniques in addition to addressing the development of rapid diagnostics, HVAC interactions, seasonal fluctuations, and durability.

2. Relevance to radon issue - Cost-effective radon mitigation techniques applicable to homeowners will be developed and demonstrated.

EPA-137 Radon Mitigation Development and Demonstration Program - Maryland Existing Home Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - The objective of this project is to pursue low cost mitigation techniques for houses with relatively low to moderate initial radon concentrations. The effectiveness of sealing alone, passive soil ventilation and house pressure control will be studied. Nineteen houses have been mitigated in Phase I of this project. Phase II will begin in 1989.

2. Relevance to radon issue - Through this research cost-effective radon mitigation techniques applicable to homeowners will be developed and demonstrated.

ENVIRONMENTAL PROTECTION AGENCY

EPA-138 Radon Mitigation Development and Demonstration Program - Maryland/Virginia New Construction Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	Ryan Homes
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - Radon resistant construction features are being incorporated into approximately 3,000 Ryan Homes in Maryland and Virginia. Upon request, Ryan Homes will provide a free charcoal canister for radon testing. EPA will study approximately fifteen of these homes and evaluate the effectiveness of the radon resistant construction features.

2. Relevance to radon issue - Through this research cost-effective radon mitigation techniques applicable to homeowners will be developed and demonstrated.

EPA-139 Radon Mitigation Development and Demonstration Program - Nashville, Tennessee Existing Home Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - The objective of this project is to provide an in-depth look at various techniques which can be used to mitigate houses with crawl spaces. Additionally, this project will include a few older basement and crawl space combination houses. The second phase of this project will focus on the most effective crawl space mitigation techniques.

2. Relevance to radon issue - Through this research cost-effective radon mitigation techniques applicable to homeowners will be developed and demonstrated.

ENVIRONMENTAL PROTECTION AGENCY

EPA-140 Radon Mitigation Development and Demonstration Program - New Jersey New Construction Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	New Jersey Department of Community Affairs National Association of Home Builders
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - This project is a two-phase effort to design, construct, and test 100 radon resistant houses in New Jersey. The first phase (25 houses) is in progress. Various combinations of both passive and active systems will be tested.

2. Relevance to radon issue - Through this research cost-effective radon mitigation techniques applicable to homeowners will be developed and demonstrated.

EPA-141 Radon Mitigation Development and Demonstration Program - New Jersey New Construction Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	NYSERDA
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - The objective of this project is to develop and demonstrate radon prevention techniques that can be used by builders during house construction. Combinations of sealing and passive drain tile and subslab ventilation are being installed during the construction of fifteen block basement houses. Radon resistant construction techniques will be installed and monitored by the fall of 1988.

2. Relevance to radon issue - Through this research, radon resistant construction techniques that can be used by home builders will be developed and demonstrated.

ENVIRONMENTAL PROTECTION AGENCY

EPA-142 Radon Mitigation Development and Demonstration Program - New York Existing Home Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - This project will demonstrate radon reduction techniques in sixteen houses in two radon prone areas of New York. The houses chosen represent six different house structure types. This field study also includes the evaluation and repair of fourteen mitigation systems in houses mitigated four years ago. These systems were evaluated for their durability and effectiveness in reducing indoor radon levels.

2. Relevance to radon issue - Cost-effective radon mitigation techniques applicable to homeowners will be developed and demonstrated.

EPA-143 Radon Mitigation Development and Demonstration Program - Ohio Existing Home Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - The objectives of Phase I of this two phase project are to adapt selected mitigation techniques which have proven effective in other locations to the geologic and construction conditions of Ohio, and to develop and demonstrate approaches (e.g., sealing) for reducing radon levels in basement houses with only slightly elevated levels. The house substructure types selected include block and poured concrete wall basement, crawl space, and slab-on-grade with initial radon levels in the moderate range.

2. Relevance to radon issue - Cost-effective radon mitigation techniques applicable to homeowners will be developed and demonstrated.

ENVIRONMENTAL PROTECTION AGENCY

EPA-144 Radon Mitigation Development and Demonstration Program - Tennessee/Alabama Existing Home Field Project
(Same as TVA-102)

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	Department of Energy Tennessee Valley Authority
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - This diagnostics project includes four houses in Oak Ridge, Tennessee and four houses in Huntsville, Alabama. Mitigation will focus on crawl space ventilation, decoupling of the crawl space, and house pressure control. Diagnostic procedures specific to crawl space and basement houses will be tested and refined for cost-effectiveness.

2. Relevance to radon issue - Cost-effective radon mitigation techniques applicable to homeowners will be developed and demonstrated.

EPA-145 "Radon Reduction Methods: A Homeowner's Guide"

Type of Activity:	Education
Primary Funding Agency:	EPA Office of Research and Development
Other Funding Agency:	None
Funding for FY 88::	N/A
Status:	Ongoing
Principal Contact:	A.B. Craig, Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - Research information gathered from the various field projects is incorporated into this brochure. The format is easy to follow, and provides homeowners with information on the applicability, limitations, and estimated cost of various radon mitigation techniques.

2. Relevance to radon issue - This brochure provides the most up-to-date information on radon mitigation techniques.

ENVIRONMENTAL PROTECTION AGENCY

EPA-146 "Radon Reduction Techniques for Detached Houses"--Technical Guidance Manual

* Type of Activity:	Education
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202)382-2583

* Activity Description:

1. Research objectives - The objective of this project is to consolidate and summarize the research information gained from various field projects into one technical guidance document.

2. Relevance to radon issue - This publication provides the most recent research information on radon mitigation techniques to State and Regional officials, mitigation contractors, and interested homeowners.

EPA-147 School Mitigation Demonstration Program

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	New
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - Radon mitigation techniques will be designed and installed in representative schools, and optimized to achieve the greatest degree of radon reduction. One of the objectives is to establish a relationship between the physical characteristics of the building (i.e., heating, ventilation, and air conditioning system) and the influence on radon levels.

2. Relevance to radon issue - Under this program, cost-effective radon mitigation techniques for school buildings will be developed and demonstrated.

ENVIRONMENTAL PROTECTION AGENCY

EPA-148 Study of Sealants and Coatings

* Type of Activity:	Applied Research
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - Laboratory measurements are underway to characterize radon entry routes and to study a number of potential surface sealants and coatings. Air flow rates induced through concrete block walls are monitored. A variety of coatings are being tested for their effectiveness in reducing these measured flow rates.

2. Relevance to radon issue - If proven successful, sealing can be a potentially inexpensive radon reduction technique used alone or in combination with other methods.

EPA-149 Radon Mitigation Development and Demonstration Program - New York New Construction Field Project

* Type of Activity:	Applied research, field study
* Primary Funding Agency:	EPA Office of Research and Development
* Other Funding Agency:	NYSERDA
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	A.B. Craig Air and Engineering Research Laboratory Research Triangle Park, North Carolina 27711 (919) 541-2824
* Other Contact:	Lynnann Hitchens U.S. Environmental Protection Agency (202) 382-2583

* Activity Description:

1. Research objectives - Combinations of sealing and passive drain tile and subslab ventilation are being installed during the construction of fifteen block basement houses. Radon resistant construction techniques will be installed and monitoring will be in progress by the fall of 1988.

2. Relevance to radon issue - Radon prevention techniques that can be used by builders during house construction will be developed and demonstrated.

OFFICE OF POLICY, PLANNING, AND EVALUATION

ENVIRONMENTAL PROTECTION AGENCY

EPA-150 New York State Radon Risk Communication Study

* Type of Activity:	Education, operational program
* Primary Funding Agency:	EPA Office of Policy, Planning, and Evaluation
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	Reed Johnson U.S. Environmental Protection Agency (202) 382-4396
* Other Contact:	Ann Fisher U.S. Environmental Protection Agency (202) 382-5500

* Activity Description:

1. Research objectives - This study is examining alternative ways of presenting radon risk information to homeowners who have had their home tested. The information being tested varies along two major dimensions. The first is the degree of quantification of the explanations about radon risk, and the second is the degree to which the information tells people what they should do (compared with asking them to weigh information and make a judgment). Four experimental booklets are being tested, along with the Citizen's Guide and a one-page fact sheet. The data are being collected from homeowners in New York State. Baseline data were gathered before they received risk communication materials, and two follow-ups have been conducted. The first was after they received a two-month radon reading and the second after they received an annual reading. Final data collection will be in the Fall of 1988, to test the relative effectiveness of the alternatives on mitigation decisions.

2. Relevance to radon issue - Preliminary information from Maine showed that nearly half of a sample reported having mitigated, even though far less than half had radon levels above the action guidelines. Even worse was the fact that there was no relation between the radon level and whether people had mitigated. Some people were spending substantial sums to reduce already low radon levels, while others were not mitigating high levels. The NYS data should allow us to make recommendations about how to motivate those at higher levels to mitigate, without having those at low level undertake unnecessary mitigation.

EPA-151 Region III/Maryland Radon Risk Communication Study

* Type of Activity:	Education, operational program
* Primary Funding Agency:	EPA Office of Policy, Planning, and Evaluation
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	Nancy Zahedi U.S. Environmental Protection Agency (202) 382-5355
* Other Contact:	Carol Deck U.S. Environmental Protection Agency (202) 475-7399

* Activity Description:

1. Research objectives - This study is examining alternative ways of communicating about radon risk so that homeowners will have their homes tested. Baseline data were collected in three communities prior to alternative information treatments (December 1987). One community serves as a comparison community. The other two receive different combinations of multiple hit/multiple channel information about why they should test and how they can do it. The alternatives include utility bill inserts, radio public service announcements, posters in public places, fliers for doctors' offices and supermarkets, a local radon awareness week sponsored by the mayor and town council, and a slide show with script to be presented by local influentials. Follow-up data were collected in April 1988.

2. Relevance to radon issue - EPA has relatively little data to guide a radon risk communication strategy for the objective of getting people to test their homes for radon. This study will suggest the relative effectiveness and relative costs of alternative elements that could be included in such a strategy.

ENVIRONMENTAL PROTECTION AGENCY

EPA-152 Comparison of Reaction to Radon Risk in Three Communities

* Type of Activity:	Education, operational program
* Primary Funding Agency:	EPA Office of Policy, Planning, and Evaluation
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Nearly complete
* Principal Contact:	Ann Fisher U.S. Environmental Protection Agency (202) 382-5500
* Other Contact:	Reed Johnson U.S. Environmental Protection Agency (202) 382-4396

* Activity Description:

1. Research objectives - This study is examining the community reaction to radon risk in three communities (Boyertown, PA; Clinton, NJ; and Vernon, NJ) known to have elevated radon levels. The purpose was to glean risk communication lessons from a retrospective evaluation of actual experiences. In Vernon, the radon of primary concern was caused by radium wastes from painting watch dials. Outrage there was high. Both Boyertown and Clinton had high geological radon, but there was relatively little outrage in Boyertown and concern in Clinton was calmly converted into mitigation. The draft final report (March 1988) suggests that personalities of the communicators and openness of information provision explain some of the differences.

2. Relevance to radon issue - The findings suggest some strategies at the community level for stimulating awareness and action in response to information about nearby elevated radon levels.

EPA-153 Research on Integrated Radon Risk Communication Strategy

* Type of Activity:	Education, operational program
* Primary Funding Agency:	EPA Office of Policy, Planning and Evaluation
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	New
* Principal Contact:	Alan Carlin U.S. Environmental Protection Agency (202) 382-5499
* Other Contact:	Ann Fisher U.S. Environmental Protection Agency (202) 382-5500

* Activity Description:

1. Research objectives - This study will examine the effectiveness of intensive information campaigns (similar to the WJLA/Channel 7 campaign in Washington, DC) in getting people to test their homes for radon and take appropriate mitigating action. It also will explore the potential effectiveness of point-of-sale testing requirements for residences.

2. Relevance to radon issue - The results will be useful for designing radon risk communication strategies.

GENERAL SERVICES ADMINISTRATION - NATIONAL CAPITAL REGION

GENERAL SERVICES ADMINISTRATION - NATIONAL CAPITAL REGION

GSA-101 Radon in Public Buildings Study

* Type of Activity:	Field study
* Primary Funding Agency:	GSA-NCR
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	New
* Principal Contact:	Marybeth Stewart General Services Administration-NCR-WPX 7th & D Street, S.W. Washington, D.C. 20407 (202) 453-5236
* Other Contact:	Cherylynne Williams General Services Administration-NCR (202) 453-5236

* Activity Description:

1. Research objectives - This study will provide information useful in developing guidelines for acceptable radon levels in public buildings and provide data on potential health problems associated with radon exposure in public buildings. Government owned buildings in NCR will be surveyed. Site-specific study protocols will be developed. Initial sampling will be with alpha track detectors, for approximately 90 days. Follow-up sampling and remediation will be performed as necessary. It is anticipated that EPA recommended criteria (e.g, acceptable levels, remediation triggers) for homes will be used as an initial guide.

2. Relevance to radon issue - This study should provide information which may be used together with other public building radon information to assess acceptable levels, risks, and remediation effectiveness in public buildings.

LIBRARY OF CONGRESS, CONGRESSIONAL RESEARCH SERVICE

LIBRARY OF CONGRESS. CONGRESSIONAL RESEARCH SERVICE

CRS-101 Reports to Congress on Science & Technology Issues

* Type of Activity:	Educational, operational program
* Primary Funding Agency:	Congress
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	Christopher H. Dodge Library of Congress Science Policy Research Division, Congressional Research Service LM 413 Washington, D.C. 20540 (202) 287-7071
* Other Contact:	N/A

* Activity Description:

1. Research objectives - The goal of this project is the publication of a CRS Issue Brief (#86144) entitled "Radon: Congressional and Federal Concerns."

2. Relevance to radon issue - This publication reviews the radon problem and Congressional and Federal approaches to solutions.

TENNESSEE VALLEY AUTHORITY

TENNESSEE VALLEY AUTHORITY

TVA-101 Radon in Multifamily Public Housing

* Type of Activity:	Field study
* Primary Funding Agency:	Tennessee Valley Authority
* Other Funding Agency:	EPA
* Funding for FY 88:	Information not available
* Status:	Final Year 1986
* Principal Contact:	William J. Parkhurst Division of Air and Water Resources 407 MPB Muscle Shoals, Alabama

* Other Contact:

* Activity Description:

1. Research objectives - The objective of this project is to examine the distribution of radon levels in over 200 multifamily low-income units in five Chattanooga public housing developments.

2. Relevance to radon issue - This project is one of the first efforts to characterize radon distribution in low-income, public housing.

TVA-102 Investigation of Radon Entry into Houses and the Effectiveness of Mitigation Measures
(Same as EPA-144)

* Type of Activity:	Field study
* Primary Funding Agency:	EPA
* Other Funding Agency:	TVA, DOE
* Funding for FY 88:	Information not available
* Status:	Final Year 1988
* Principal Contact:	R.H. Rainey, Jr. Office of Power Environmental Coordination Staff
* Other Contact:	

* Activity Description:

1. Research objectives - The objective of this project is to conduct extensive pre- and post-mitigation monitoring of eight houses with indoor radon levels greater than 10 pCi/l. Effects of building structure, air infiltration, building depressurization, and climate are examined with respect to radon entry and removal from the structure.

2. Relevance to radon issue - This project will evaluate the effectiveness of radon control technology for two structural types (e.g., crawlspace and raised rancher) common in the Southeastern United States.

TENNESSEE VALLEY AUTHORITY

TVA-103 300-Hour Kingston/Harriman Multipollutant Field Study

* Type of Activity:	Field study
* Primary Funding Agency:	Tennessee Valley Authority
* Other Funding Agency:	CPSC, Electrical Power Research Institute
* Funding for FY 88:	Information not available
* Status:	Final Year 1987
* Principal Contact:	R.H. Rainey, Jr. Office of Power Environmental Coordination Staff

* Other Contact:

* Activity Description:

1. Research objectives - Part of the nationwide HSPS 6-city study, the Kingston/Harriman phase comprised a significantly expanded design and protocol to examine the distribution of indoor air pollutants (including radon) and airborne microorganisms. The study examined the influence of season, heating fuel, tobacco smoking, and building characteristics on indoor air pollutant levels. Health studies were undertaken on children residing in the study houses.

2. Relevance to radon issue - This intensive field monitoring program was conducted in one county and examined in-depth factors influencing radon levels in housing.

TVA-104 Building Risk Assessment

* Type of Activity:	Field monitoring, operational program
* Primary Funding Agency:	Tennessee Valley Authority
* Other Funding Agency:	None
* Funding for FY 88:	Information not available
* Status:	Ongoing
* Principal Contact:	Ron Maxwell Multipurpose Building Muscle Shoals, Alabama 35660 (205) 386-2767

* Other Contact:

* Activity Description:

1. Research objectives - A building risk assessment monitoring activity is in progress as a part of the overall agency health and safety program. Various parameters and potential indoor contaminates such as asbestos, biological agents, fumes, etc. are monitored. Radon has recently been added to the list of contaminates monitored.

2. Relevance to radon issue - Determination of radon in the workplace will allow comparison to EPA guidelines and evaluation of the need for any mitigation.

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APPENDICES

RADON WORKGROUP CHARTER

CHARTER OF THE RADON WORK GROUP OF THE COMMITTEE ON INDOOR AIR QUALITY

This charter outlines the authority for the formation of the Radon Work Group of the Interagency Committee on Indoor Air Quality. It establishes the structure, operation, and objectives of the work group.

AUTHORITY

The Radon Work Group is a standing work group. It was formed as part of the formal structure of CIAQ which required that standing and ad hoc work groups be organized to address specific issues of indoor air quality. These groups were formed with authorization from:

- H.R. 2899, Report Number 98-212 and
- SARA Title IV.

STRUCTURE

The Radon Work Group is co-chaired by the Environmental Protection Agency and the Department of Energy. Membership in the work group is open to all Federal agencies. Each agency designates one official delegate for voting purposes.

OPERATION

Achieving a consensus among member agencies is a desireable goal. In instances where consensus is not feasible, voting will take place. Official delegates will assume responsibility for coordinating input from other members within their respective agencies. Each agency will cast one vote representing consensus of those members. Decisions will be made through a majority vote.

The Radon Work Group will meet four times a year and report its progress at full-member CIAQ meetings. In order to facilitate communication between CIAQ and the work group, the group proposes to:

- Report to CIAQ at their regularly scheduled meetings,
- Maintain contact between CIAQ co-chairs and work group co-chairs on an as needed basis, and
- Accept assignments for special projects from CIAQ or any work group member agency.

OBJECTIVES

The Radon Work Group will coordinate activities related to radon and develop Federal responses to radon related issues. To achieve these objectives the work group will:

- Identify and discuss technical and non-technical interagency issues;
- Review member agency research and program plans;
- Plan and implement joint projects and coordinate multi-agency participation in radon related activities; and
- Produce and publish information related to radon activities.

Specific objectives defined for implementation in FY 88-89 are:

- Organize meetings concerning special topics related to radon;
- Create and disseminate a directory of work group members to encourage interagency communication; and
- Develop and publish an inventory of Federal radon projects and activities.

RADON WORKGROUP MEMBERSHIP LIST

THE RADON WORKGROUP MEMBERSHIP LIST

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