The *NORM* Report

Naturally Occurring Radioactive Material Contamination
SPRING 96

Index

The NORM Report

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Regulations for the Control of NORM - Update

The states of regulations for the control of NORM is summarized below for 19 states, the federal government and Canada. Significant developments have occurred in Mississippi, Washington, and the Minerals Management Service. Each regulatory agency was contacted during the period from June 4-19.

The last states to enact NORM regulations were New Mexico and South Carolina. Their regulations were summarized in the Summer 1995 issue of **The NORM Report**. Louisiana, Oregon, Mississippi, Arkansas, Texas and Georgia have previously enacted regulations for the control of NORM.

There currently are no federal rules specifically for the control of NORM.

Enactment of regulations specifically for the control of NORM will require compliance by industries and companies with NORM contamination and NORM waste materials. Companies should already be in compliance with state general regulations for the control of radiation and the OSHA radiation regulations.

The status of NORM regulations in all 50 states, the federal government and Canada will be summarized in the Summer 96 issue of **The NORM Report.**

ALASKA

Alaska is preparing a draft proposal to the EPA and other federal agencies for funding to finish writing their NORM regulations. The state has cut the budget for radiation programs and only minimal funding is available.

Alaska does have guidelines which can be used when necessary for disposal of NORM. For example, CEI is working in a pipeyard at Kenai and the NORM wastes will be injected into a disposal well. These guidelines provide a basis for evaluating requests to dispose of NORM resulting from the production of oil and gas within the State. The guidelines apply to material exhibiting gamma radiation levels greater than 50 microrem per hour as given in API Bulletin E2, first edition, April 1, 1992: ***Bulletin on the Management of Naturally Occurring Radioactive Materials in Oil and Gas Production.*** These guidelines are:

Requirements for NORM Disposal

Sources for NORM Disposal:

1. Source of NORM material must be from within the State of Alaska.
2. Material type must be scale, scaled tubulars, contaminated soil, basic sediment, sludge, tank bottoms, other RCRA exempt oil & gas waste, etc.

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ALASKA (continued)

3. Disposal volume is to be given in cubic feet, barrels, or length and diameter of tubing string.
4. For disposal under these guidelines, the radiation exposure level(s), based on a representative composite sample, must be less than 2,000 microrem per hour (uRem/hr).
5. Radiation level(s) must be recorded for each source. Several containers from the same source may be measured as a group and the highest reading used to describe the source.

Disposal Methods and Requirements:

6. Below the lowermost USDW, NORM can be slurried and injected into a Class II well.
7. NORM can be disposed of in the open-hole section of an AOGCC permitted well provided the lowermost USDW is behind pipe and the NORM is isolated in the wellbore between minimum 100 foot cement plugs, the top of which is at least 100 feet below the lowermost non-exempt USDW.
8. Within a cased hole, the NORM must be isolated between minimum 100 foot cement plugs (or cement retainer with a minimum 50 foot cap) the top of which is at least 100 feet below the lowermost non-exempt USDW.
9. The casing must be well cemented opposite the upper cement plug, as indicated by a cement quality log, or the casing must be perforated and squeezed with a quantity of cement calculated to provide 150 feet of fill in the annulus based on a caliper quality.
10. The top of the upper plug must be tagged to confirm location and cement quality.
11. The cement plug immediately above the NORM must be color-dyed red with iron oxide or a suitable alternate as approved by the Commission.
12. NORM shall not be used as admixtures in cements used for well plugs.

Marking and Reporting:

13. The marking plate must contain the word "NORM" in addition to the information required by regulation 20 AAC 25.120 (name of operator, unit or lease name, and well number); for offshore wells, surface markings must be as agreed to by the AOGCC at that time.
14. The abandonment report shall contain a section specific to NORM disposal which shall provide "as-built" information pertinent to the criteria listed above.

ARKANSAS

Some changes have been proposed in the Arkansas regulations for the control of NORM. One change proposed will exempt equipment contaminated with NORM if the maximum radiation exposure does not exceed 50 microrem per hour including background at any accessible point.

Other changes proposed include the requirement to make NORM surveys similar to those required in Louisiana.

The legislature has approved the proposed changes which will probably become effective in August or September.

CALIFORNIA

The consensus report detailing the results from the survey of petroleum facilities for NORM contamination in California still has not been released to the general public. In addition to gamma surveys, water, brine, soil and other appropriate samples were taken for laboratory analysis. Both the Department of Health and the Department of Conservation are currently trying to get permission to get the report released to the public.

COLORADO

Envirocare of Utah has sued the State of Colorado and others within Colorado over the disposal of some radioactive waste that had been sent to a solid waste landfill.

Envirocare argues that the waste should have been sent to a disposal site licensed to receive radioactive wastes.

There was a pile of mining wastes near the city of Golden. A water main broke several years ago threatening to flood the tailings pond. EPA came in under its CERCLA authority and removed the tailings pond and its sediments and put it in a pile and ordered a number of parties, including the State of Colorado, to remove it under CERCLA.

The state and the other parties studied the pile and concluded that it was not special nuclear wastes, and it was not low level waste. They did determine there was a very small component of by-product material (uranium tailings) and source material in the wastes. Because the vast majority of this material was other things, the state determined that it was a special solid waste which is a category of solid wastes recognized under state law, and therefore, could go to a solid waste landfill. The EPA agreed and issued an order to the State and the other parties to remove the wastes to a solid waste

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COLORADO (continued)

landfill. This has been done.

Envirocare of Utah sued, arguing that the material cannot be called special solid waste and can only be disposed of in a facility licensed for radioactive material. The State vigorously disagreed.

On February 2, 1996, Envirocare filed a motion for a temporary restraining order. The State filed a motion to dismiss.

On February 5, 1996, Envirocare filed a motion for a preliminary junction.

On March 10, 1996, the District Court granted dismissal of the suit on jurisdictional grounds.

Envirocare has now filed suit against EPA in federal court.

CONNECTICUT

The Connecticut Department of Environmental Protection (DEP) has prepared a proposal to have a contractor prepare a draft of proposed regulations for the control of low level radioactive wastes, including NORM and NARM.

The proposal is currently undergo- review within the DEP.

FLORIDA

In April the Florida Institute of Phosphate Research approved the state's request to fund a comprehensive study of NORM in the phosphate industry. The Institute, located in Bartow and affiliated with the University of South Florida, selected the Polk County Public Health Unit and a private consulting firm to conduct the 18 month study as a joint project beginning in July. The study will identify and evaluate the extent of occupational and public radiation exposure risks related to phosphate NORM.

The Florida Advisory Council on Radiation NORM Committee, formed in response to the state's request for recommendations on regulatory approaches to NORM, held its first meeting in April. The committee will report to the Council in October.

In an on-going effort to improve the characterization of NORM in Florida, state personnel have been conducting informal site surveys of NORM generators. Phosphate and heavy mineral sand mining operations in north-central Florida were inspected in May, and oil field operations in the Panhandle region were surveyed in June. Surveys of oil fields located in the southwest part of the state are being planned.

Although Florida does not have specific NORM rules, the state does regulate some NORM. There are specific licenses for about a dozen chemical plants, but only for the chemical side of the phosphate industry where it is known that NORM contamination may exceed radiation protection standards.

GEORGIA

Georgia's regulations for the control of NORM became effective in October, 1994. There have been no changes in the rules since that time. However, the rules and regulations are currently being reviewed and changes proposed for adoption by the Board in December 1996.

ILLINOIS

Illinois's approach to NORM regulations is being reviewed to decide if general NORM regulations should be proposed, or whether rules should be written to address the NORM problems in certain sections of selected industries who have the potential for NORM contamination. No decision as to the approach to be proposed has been made yet. The Department of Nuclear Safety may go with the approach of identifying known NORM problems and writing specific rules for those problems. As new NORM problem areas are identified, new rules will be written to cover them. This approach may be preferable to generic rules which cover the whole world of NORM and results in too much unnecessary regulations without much benefit. This approach to NORM rule making is the result of reviewing the in-depth comments made on the latest (1994) CRCPD draft. There is no time schedule for the NORM rule making in Illinois.

KENTUCKY

The Department of Health Services is working with the Kentucky Department of Environmental Protection to locate a suitable site for the long term storage of the NORM wastes resulting from the remediation of the Martha Oil Field.

LOUISIANA

It is expected that the new governor may ask for significant reductions in state regulations. However, the reduction has not been officially mandated throughout the state regulatory agencies. There are no immediate plans to make any charges in the Louisiana NORM regulations or in the NORM Implementation Manual.

There have been discussions about removing the NORM manifest requirements from the NORM regulations. The manifest requirements will be replaced with receipt of transfer for movements of NORM equipment and waste. Companies will be allowed to use any method or system (they may choose to continue using the NORM manifest) to comply with

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LOUISIANA (continued)

requirements (e.g., shipping tickets, tracking log, etc.)

The oil and gas industry in Louisiana has had access to economical and accessible disposal of NORM-contaminated equipment and waste. However, this is not true of non-oilfield related NORM wastes such as those found in the petrochemical and chemical industries. The Office of Conservation forbids non-oilfield NORM wastes to be considered for disposal at NOW disposal facilities.

When approached by the petrochemical industry concerning disposal options for their refinery NORM wastes, the DEQ has been unable to provide any options except to send the wastes to Envirocare or US Ecology. Most operators would prefer to send the wastes to hazardous waste or solid waste landfills.

Some large NORM-contaminated sites in Louisiana remain unremediated. There are no provisions in the state NORM regulations mandating clean-up of such sites.

MICHIGAN

Effective April 1, 1996, the Radioactive Materials Program formerly in the Michigan Department of Health has been transferred to the Michigan Department of Environmental Quality.

For the past 1 1/2 years Michigan's Division of Radiological Health in the Department of Public Health has been dealing with some large sites heavily contaminated with radium from luminous aircraft dials of World War II vintage.

In one instance a family had lived in a house for 30 years. During that time. the basement in the house was used in a business calibrating and refurbishing aircraft instruments for a large warehouse distributor. As a result of opening the gauges and refurbishing the surfaces, the deterioration of these old gauges over the years caused radium to be dispersed throughout the house and the backyard of the house and a neighbor's yard as well.

The family residence has been decontaminated. Decontamination of the two warehouses associated with the business will start this summer.

MISSISSIPPI

Responsibility for NORM in Mississippi is divided between the Department of Health and the Oil and Gas Board. The Oil and Gas Board has authority for NORM at the wellsite (effective July 1, 1995). Once the petroleum leaves the wellsite, the Mississippi Department of Health has continued authority for NORM contamination.

The Department of Health has no new developments in its area of responsibility for NORM. The Department does continue to be heavily involved in NORM.

On August 11, 1995, the Oil and Gas Board issued a proposed Rule 69: ***Control of Oil Field*** **NORM.** The rule provides the regulations for the control of oilfield NORM to ensure that radiation exposures of workers and members of the general public are negligible. The rule applies to NORM that has been derived from the exploration and production activities of oil and gas operations within the State of Mississippi

A public hearing on Rule 69 was to have been held in January. This was postponed until March and at the request of attorneys on both sides of the issue, the hearing was again postponed until April 2-4, 1996. The changes made to the August draft were summarized in the Winter 96 issue of **The NORM Report.**

Following the three-day public hearing, Rule 69 was adopted by the Oil and Gas Board with only a few minor technical changes. The ruling has been appealed but the rule is expected to be upheld. Oil and Gas Board rulings have been overturned only one time in the history of the Board.

NEW JERSEY

The New Jersey Commission on Radiation Protection is considering proposing remediation standards for radioactive materials. The Commission was directed to establish generic soil cleanup criteria for the remediation of contaminated sites. The criteria for soil standards were to be based on either: (1) an incremental lifetime risk of cancer of one in a million persons exposed, or (2) naturally occurring background levels that are consistently encountered. Details of the proposed standard were given in the Winter 96 issue of **The NORM Report.**

The comment period for the interested party draft of N.J.A.C. 7:28-12, ***Remediation Standards for Radioactive Materials,*** ended on May 24, 1996. Two public hearings were held in April, 1996. Written and oral comments focused on the derivation of the 15 mrem annual cleanup criteria, the selection of parameter values in the pathway analysis, and the economic impact of the rule. The Bureau of Environmental Radiation is planning to address the comments and propose the rule. There is no estimated schedule set for publication of the proposed rule as yet.

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NEW MEXICO

The New Mexico NORM regulations, Subpart 14: ***Naturally Occurring Radioactive Materials (NORM) in the Oil and Gas Industry*** became effective August 3, 1995.

A task force from the Oil Conservation Commission has come up with some proposed rule changes to allow for the disposal options that are addressed in Part 14 NORM regulations. There will be a public hearing before the Oil Conservation Commission to consider the proposed changes. Unless unexpected opposition to the proposed changes arise in the public hearing, the Commission is expected to adopt the changes which will become effective 30 days later.

OHIO

Ohio's revised general regulations for the control of radiation are presently being reviewed by a subcommittee selected by the Radiation Control Advisory Council, NORM is included in the revised regulations as part of the preparation for Agreement State status. It is hoped that the revised rules will be finalized by fall.

The proposed rules are not yet available for distribution. By the time they are ready for comment, the Bureau of Radiological Health hopes to have a Web page that people will be able to access by e-mail. The final rules document is expected to be several hundred pages in length.

Although Ohio does have NORM contamination problems in their oil and gas industry, the problems are small when compared with such oil producing states as Louisiana, Mississippi and Texas.

OKLAHOMA

A meeting of the Oklahoma Radiation Management Council was held on June 6. A public forum on the management of naturally occurring radioactive materials (NORM) followed the meeting. The purpose of the forum was to allow discussion of issues and gathering of information on NORM related issues in a less formal setting than the regular Advisory Council format. Two main topics of discussion were disposal options and licensing. The Council received many good comments and concerns from the approximately 30-40 people present. Various industries and the public were represented.

The Council will begin preparing draft 13 of proposed NORM regulations for Oklahoma. They hope to have the draft ready for discussion at the September 5th meeting of the council.

SOUTH CAROLINA

Part IX-*Licensing of Naturally Occurring Radioactive Material (NORM)* became effective June 30, 1995 in South Carolina. There have been no changes in the regulation and none are proposed at the present time.

Part IX was summarized in the Summer 1995 issue of **The NORM Report.**

TEXAS

The Texas Department of Health has jurisdiction for NORM except for the disposal of NORM. The Railroad Commission has jurisdiction for the disposal of oil and gas industry NORM wastes, while the Texas Natural Resource Conservation Commission has responsibility for the disposal of non-petroleum industry NORM wastes.

The Department of Health is still planning to make some modifications to their NORM rules. The revisions have been delayed because of other higher priority matters. The NORM revisions should be completed during the next year. The changes will primarily be in classifications of NORM and adding some requirements for processing of NORM from other persons. These revisions will be coordinated with the Railroad Commission, particularly where they concern jurisdictional issues or where processing and desizing are being done at the same time.

Statewide Rule 94: ***Disposal of Oil and Gas NORM Waste*** took effect February 1, 1995. This rule sets forth requirements for the safe disposal of NORM that constitutes. Is contained in, or has contaminated oil and gas waste. Rule 94 was summarized in the Winter 95 issue of **The NORM Report.** There are no plans at present to revise Rule 94.

The Texas Natural Resources Conservation Commission has not started drafting disposal rules yet for non-oil and gas NORM wastes. When the general radiation rules from the Department of Health have been revised where necessary, it may be possible to start drafting the NORM disposal rules for the non-petroleum industries.

WASHINGTON

US Ecology filed a lawsuit challenging the 1995 amendments to WAC 246-249-080 which limited the disposal of NARM waste at the commercial low-level radioactive waste disposal facility in Richland to 8600 cubic feet per year.

A settlement agreement between the Washington State Department of Health and US Ecology was

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WASHINGTON (continued) reached on May 15, 1996. Under the Agreement the Department of Health agreed to initiate rulemaking to consider a 100,000 cubic foot limit and US Ecology agreed to dismiss its action. The court has entered an order staying operation of the amendment and imposing a 100,000 cubic foot limit during the pendency of the rulemaking proceeding.

Rulemaking will move ahead, consistent with the requirements of Washington's Administrative Procedures Act. The earliest possible date for public hearings will be the last week of August 1996. Two hearings will be held: one in Richland, and one in Olympia

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Although radon in occupied structures is generally not a primary concern in NORM industrial contamination, the EPA considers radon emanation from NORM to be one of the most hazardous features of NORM, particularly as it may increase the radon concentrations in nearby structures where people may be working or living.

The Office of Radiation and Indoor Air (who probably will have the responsibility for proposing regulations for the control of NORM) has merged the Radon Division, the Indoor Air Division and the Electromagnetic Fields Program into a new Indoor Environments Division directed by Mary Smith.

Prompting the merger was a decision by new ORIA Director E. Ramona Trovato to combine radon and other indoor-air issues in order to achieve more efficient program management and effective program strategy.

Driving the timing of the merger was a government wide effort to streamline agencies. In the Environmental Protection Agency, the goal was to reduce the ratio of employees to managers to 11:1.

Radon publications are now out there on the Information Superhighway. Those who have access to the Internet can find the publications on the home page of the EPA's Office of Air and Radiation (OAR) and then looking for the Office of Radiation and Indoor Air (ORIA). To be specific, type http://www.epa.gov/oar/oria_ied.html. Available for browsing or downloading are ***A Citizen's Guide to Radon, Home Buyer's and Seller's Guide to Radon, Reducing Radon Risks, Consumer's Guide to Radon, A Physician's Guide to Radon, Radon Measurement in Schools (revised edition), El Radon, Model Standards and Techniques for Control of Radon in New Residential Buildings, Radon Mitigation Standards***, a list of state radon contacts, and the Consumer Federation of America's ***Radon Fix-It Program.***

Also on the Internet are the proficiency listings of certified radon measurers and mitigators. To access the new Radon Proficiency Program, type http://www.epa.gov/radon-pro/.

NUCLEAR REGULATORY COMMISSION (NRC)

The NRC continues to monitor NORM developments but is doing nothing specific on NORM at this time.

The NRC and the Agreement states met recently (March 5/6) in Vancouver, Washington. Among the topics discussed were sealed radioactive sources that inadvertently get to scrap dealers in loads of scrap iron and steel. Most of the scrap dealers send the scrap back to its origin.

Several federal agencies are jointly preparing a manual for remediating a contaminated site for unrestricted use. Although the manual will be for contaminated federal sites, the manual will probably be the basis for state regulations for the remediation of industrial NORM contaminated sites.

The manual is discussed in four papers to be presented at the Health Physics Society annual meeting in Seattle in July. Dr Meck (NRC), one of the authors of the manual, has stated that preparation of the manual began in January, 1994 and should be ready for public comments in November, 1996, depending on the number of comments received during the intra-agency reviews. Further details of the manual are given below.

The Environmental Protection Agency (EPA), the Nuclear Regulatory Commission (NRC), the Department of Energy (DOE), and the Department of Defense (DOD--Army, Navy and Air Force) are jointly developing a single federal guidance document for investigating and characterizing sites that have been contaminated with radioactive materials. The multiagency radiation survey and site investigation manual (MARSSIM) is being written to support implementation of Federal rules, currently under development, for the cleanup of sites contaminated with radioactive materials. The MARSSIM will provide guidance for planning, conducting, evaluating, and documenting environmental and structural radiation and sampling surveys in support of remediation of radioactive contamination. The philosophy, standardized techniques and methodologies

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NUCLEAR REGULATORY COMMISSION (continued)

that form the basis for this manual are consistent with Federal limits, guidelines, and procedures. The sampling and radiation surveys that will be depicted in the manual will only entail the use of commercially available instrumentation and equipment. Survey designs and evaluation of results will incorporate standard statistical approaches.

MINERALS MANAGEMENT SERVICE (MMS)

The Minerals Management Service (MMS) has released their document on guidelines for the offshore storage and sub-seabed disposal of wastes resulting from the development and production of oil and gas in the outer continental shelf. The document is dated May 8, 1996. The document outlines specific guidelines for wastes which contain NORM above background levels.

The guidelines are reproduced herein beginning on page 10.

CANADA

The ***Guidelines for the Handling of Naturally Occurring Radioactive Materials (NORM) in Western Canada*** was released in August 1995. There are no plans to make the guidelines into regulations at the present time. It is expected that the oil and gas and the fertilizer industries will use the NORM guidelines to develop their own code of operating practices in order to give the front-line workers specific guidelines to enable them to work with NORM safely. Some questions have been raised about the report, particularly on the *de minimis* values used for bulk materials in Tables 2 and 5. I asked the Chairman of the Western Canada NORM Committee responsible for the report for clarification. Dennis Novitsky's comments follow:

To promote the continual improvement of the Western Canadian NORM Guidelines, I would like to offer my personal comments to address the concerns of some of your readers.

To reiterate, the Western Canadian NORM Committee purposefully chose to review and adopt recognized international standards which for this guideline, are embodied primarily by the IAEA and the ICRP. This resulted in the exclusion of some existing Canadian and U.S. standards. This course of action was adopted for three reasons;

1. We wanted to develop a standard which was based on science, not politics, to the greatest extent possible. This *"moral high ground"* was intentional in that national standards setting entities should begin their own unique NORM policy development based upon objective scientific information, formulated by an international pool of experts. As you know, this is not a perfect process but it was the best alternative available to the Committee.

2. Our intent was to provide a comprehensive and consistent pool of information for use by affected industries. Industry members in our Committee had pressing NORM problems to deal with straightaway and needed one set of coherent "standard practices" upon which industry codes of practice could be developed. As a result, the Committee chose to develop a Guideline, not a NORM Standard. Further, the guidelines can be much more quickly amended to reflect our improved understanding of the NORM issue as it continues in its evolution.

3. Not unlike numerous industries, an internationally based set of NORM guideline is more likely to cross national boundaries. Given the increasingly global nature of business, our industry representatives wanted to develop globally accepted guidelines, recognizing of course, the unique requirements of western Canada political boundaries. Given the infancy of NORM standards development, a more global set of guidelines is more likely to gain acceptance as a credible basis for national and perhaps, international standards development.

In this context, I would now like to address the more specific concerns about the *de minimus* values incorporated in Tables 3 and 5 of the guidelines.

Starting with Table 5, I would like to provide some additional background in the interpretation of the "Diffuse" and "Discrete" columns in the table. Diffuse NORM represents the low concentration, high volume NORM material typically found as an industrial by-product such as in fertilizer production processes. The diffuse NORM exempt activity level for each isotope was developed by IAEA working groups using pathway analysis and based upon internal and external exposure estimates associated with each exposure pathway. This type of analysis was also done by the Commission of the European Communities. In its report ***"Principles and Methods for Establishing Concentrations and Quantities (Exemption Values) Below which Reporting Is Not Required in the European Directive"***, they describe in some detail, the methodology taken to arrive at their exempt values and the critical pathway (limiting pathway) found in arriving at that value. Some NORM radionuclide exemption limits listed in Table 4

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CANADA (continued)

of the report are shown in the table below.

ISOTOPE	ACTIVITY CONCENTRATION	ACTIVITY
U-238	4.75 Bq/g	28,400 Bq
Ra-226	4.67 Bq/g	4,540 Bq
Pb-210	5.21 Bq/g	5,100 Bq
Ra-228	15.2 Bq/g	85,500 Bq
U(nat)	1.83 Bq/g	2,570 Bq
Th-228	1.50 Bq/g	8,780 Bq

These reported results compare quite favorably to our NORM Guidelines values and should be considered in complete agreement given the uncertainties associated with this type of analysis. To the less initiated, these values, if applied blindly and in isolation, could lead to potentially hazardous gamma exposures if the NORM is diffuse and extensive such as in the contaminated soil scenario. However, other standards must be considered including the direct gamma exposure limit of 0.5 µSv/h as stated in the guidelines. All applicable standards must come into play when performing a radiological hazard assessment.

In Table 3, for de minimus values of bulk materials, we chose to adopt the *"1 IAEA exempt activity concentration"* for solids which goes to the heart of my previous comments.

For Aqueous Solutions and Gases, we were compelled to modify the IAEA standards based upon other existing standards.

The IAEA standards implies aqueous activity concentrations, orders of magnitude greater than drinking water standards or permissible discharge concentrations such as those specified for uranium mines. To address this, the Committee imposed a 0.001 factor to the IAEA concentration values. Neither the IAEA standard nor the European report, explicitly address aqueous concentration limits. Since publication of the guidelines, I have received feedback concerning the aqueous limits. It appears that our 0.001 factor is too conservative and generates concentration values that are extremely difficult if not impossible to measure in the field. Portable analytical gamma spectroscopy equipment requires extremely long measurement periods in order to satisfy minimum accuracy requirements. I welcome any comments and recommendations to improve the aqueous limits in the Western Canadian NORM guidelines.

At the time of publication of the guidelines, the international scientific community was in a state of flux concerning radon gas. The latest ICRP recommendations were not available. We therefore chose to go with the existing Canadian standard. I would like to see our guideline radon concentration lim its modified to better reflect the latest ICRP recommendations. See table at the bottom of this page.

As with aqueous limits, I welcome further discussion on our current radon gas limits in the guidelines.

The intent of the Western Canadian NORM Committee was to develop a set of guidelines that would be treated as a living document. The Western Canada NORM Guidelines represent a tentative first step in progress towards developing a consistent and rational approach to the NORM issue. I welcome the opportunity to dialogue with anyone concerning the Western Canadian NORM Guidelines and extend my appreciation to the editor for this forum.

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Editor's note:
Radiation and concentration units in the Canada guidelines are in the international system (SI), e.g., sieverts and becquerels. The table below gives the conversion factors for converting SI units to conventional units, e.g., microrems and picocuries.

1 microrem = 100 microsieverts
10 microrem = 1 millisievert

1 picocurie = 0.037 becquerel
27 picocuries = 1 becquerel

■

De minimus (below the lowest public range	<200 Bq/m^3
NORM Contaminated (occupational)	<800 Bq/m^3*
Radioactive (radiation worker)	≤4.8 WLM

*The Canadian standard within the range 500-1500 Bq/m^3 specified by the ICRP.

ATION CONTROL PROGRAM DIRECTORS (CRCPD)

The 1996 Annual Meeting of the CRCPD was held in early May. During the meeting Ray Paris, the Chairman of the CRCPD NORM Commission, presented a report on the Commission's progress. Some of the key issues the Commission needs to address in drafting suggested NORM regulations include:

Some of the key issues the Commission needs to address are:

* Is there a better "definition" of NORM?
* What is the threshold for starting regulatory action?
* Where does Cost vs. Benefit factor in ?
* What is background -- how is it determined?
* Can release criteria be based on direct external measure ments only?
* Will the regulations be based upon dose or concentration limits?
* Will flexibility be permitted in site remediation? Cost and remoteness, for example. Projected land use? Past practices vs. current use?
* What is an appropriate clean-up standard? -- 10, 15, 25, 100, 500, or ? microrems/hr and 5, 10. 15, 30, or ? pCi/gm Ra-226
* Should Radon be included or excluded from calculations?
* Should ALL exposure path ways be used in calculations? (Can food pathways be exclud ed?)
* Should NORM disposal criteria be kept separate from LLW criteria?
* Is a person/organization culpable if they were unaware they had material that needed to be regulated?
* Is there a universal exposure limit or concentration limit to capture all industries?

There will be a meeting in September of The Commission and the Advisory Committee to address the issues listed above. ■

The following is an Official Position Statement of the Health Physics Society*

"LOW-LEVEL RADIOACTIVE WASTE"

Kenneth L. Mossman, Chair,
Marvin Goldman, Frank Masse,
William Mills, Keith J. Schiager

Low-level radioactive waste (LLRW) is an inevitable by-product of society's current use of radionuclides in medical research, diagnosis, and treatment of diseases, industrial processes, and electric power generation -- activities vital to our national interests, Far less waste is produced today than a decade ago because of judicious use of radioactive material, improved waste management practices, and reduction in nuclear defense activities. But LLRW will continue to be generated and disposal capacity required if society is to enjoy the benefits of these activities.

The 1980 LLRW Policy Act, as amended in 1985, established a framework for the States to provide for safe disposal of low-level radioactive waste, encouraging the creation of regional compacts to develop an appropriate network of disposal facilities. The deadlines established for the development of new facilities and the closure of existing facilities to out-of-region waste have passed with no new facilities developed. Consequently, the majority of LLRW being generated must now be temporarily stored at or near the source of generation at thousands of sites nationwide.

The goal of managing LLRW is to ensure the safety of workers and the public at large, and to protect the environment. To achieve this goal, disposal, not temporary storage, is the safest approach. Present knowledge and technology is sufficient to allow such disposal. Comprehensive regulations and practices are in place for the design, operation, and closure of LLRW disposal facilities.

The Health Physics Society strongly recommends prompt action to provide safe disposal access for all low-level radioactive waste. We urge timely completion of the facilities currently under development and accelerated cooperation among the states and regions where progress has been slower. Such actions are vital to the continued management of all radioactive materials, and the continued beneficial use of such materials. ■

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*The Health Physics Society is a non-profit scientific organization dedicated exclusively to the protection of people and the environment from radiation. Since its formation in 1956, the Society has grown to more than 6,800 scientists, physicians, engineers, lawyers and other professionals representing academia, industry, government, national laboratories, trade unions and other organizations. The Society's objective is the protection of people and the environment from unnecessary exposure to radiation, and its concern is understanding, evaluating, and controlling the risks from radiation exposure relative to the benefits derived from the activities that produce the exposures. ■

MINERALS MANAGEMENT SERVICE (MMS)

MMS has released their guidelines for the storage and disposal of offshore wastes, including NORM. The guidelines are reproduced below. The effective date of the guidelines was May 8, 1996.

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES ON THE OUTER CONTINENTAL SHELF, GULF OF MEXICO OCS REGION

Guidelines for the offshore storage and sub-seabed disposal of wastes resulting from the development and production of oil and gas on the outer continental shelf

Operators on the Federal Outer Continental Shelf (OCS) must obtain approval from the Minerals Management Service (MMS) for the storage or sub-seabed disposal of wastes generated from oil and gas development on the OCS (30 CFR 250 Subpart G). This Notice to Lessees (NTL) provides standardized guidelines for all applications for the offshore storage and sub-seabed disposal of solid wastes generated from oil and gas development on the OCS in the Gulf of Mexico Region. This NTL applies only to OCS oil and gas wastes which are exempt exploration and production wastes under the Resource Conservation and Recovery Act (RCRA). Additionally it outlines specific guidelines for wastes which contain naturally occurring radioactive materials (NORM) above background levels.

Public concern over NORM in oilfield wastes led the MMS, Gulf of Mexico Region to issue several letters to lessees (LTL's) requiring the lessees to obtain MMS approval for the discharge or disposal of solid wastes offshore. Radioactive elements and their daughter products, primarily radium-226 (^{226}Ra) and radium-228 (^{228}Ra), can be leached from geologic formations by reservoir fluids and transported to the surface with produced water, oil and gas. Radioactive material in the process stream can precipitate out as scale in tubing and processing equipment through which the production stream passes. The sludge that accumulates in the bottoms of tanks and vessels may also contain elevated levels of radioactivity.

The MMS considers applications for the sub-seabed disposal of solid wastes resulting from the production of oil and gas on the Outer Continental Shelf (OCS). Approvals were issued under authority of the OCS Lands Act, 43 U.S.C. 1334, and implementing regulations at 30 CFR 250.40 (b) (2), which grant the District Supervisor authority to approve the method of disposal of drill cuttings, sand and other well solids. Under this authority the MMS, Gulf of Mexico Region, issued a Letter to Lessees (LTL) dated November 20, 1990, directing lessees to submit a full description of the method to be used in the removal and disposal of all produced well solids, and requiring prior approval of the regional office before discharging or disposing of any such materials. A second LTL dated December 11, 1991, outlined interim guidelines for the reporting, disposal and transportation of well solids containing NORM, and also provided for approval of other methods of disposal such as encapsulation in abandoned wellbores and injection into depleted reservoirs on a case-by-case basis.

In March, 1993, the Environmental Protection Agency's (EPA) Effluent Guidelines set a zero discharge limit for produced sand. The new zero discharge limit was implemented in the Gulf of Mexico by modifying the National Pollutant Discharge Elimination System General Permit GMS290000 for EPA's Region 6 (the OCS area west of the Mississippi River outflow), and became effective on January 3, 1994. As a result of this modification, the Gulf of Mexico Region sent out a third LTL dated January 28, 1994 indicating that MMS will no longer approve applications for overboard discharge of produced well solids which includes well solids containing NORM. This NTL remains currently in effect.

The guidance contained in this NTL supersedes all specifications contained in the LTL dated December 11, 1991. MMS is no longer requiring industry to report onshore disposal of solid waste materials generated during OCS oil and gas production. The following guidelines do not supersede, but are supplemental to, those procedures for abandonment of wells as specified in 30 CFR, Chapter II, Subpart G.

I. **TYPES OF WASTES**

A. All applications for disposal of wastes covered by this NTL should, at a minimum:

1. be generated from OCS oil and gas development and production activities (a slurry will be considered solid wastes); and
2. be exempt exploration and production wastes under the Resource Conservation and Recovery Act

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(RCRA).

3. When NORM is present above background levels the operator should provide additional radiation information as outlined below.

II. DISPOSAL CRITERIA

A. Encapsulation Criteria

1. As a general rule, the MMS will not approve applications for abandoned wells as disposal locations if any of the following conditions exist:
   a. The top of the waste is less than 3,000 feet below the seafloor, and a fault intersects the wellbore within this zone;
   b. A fault intersects the wellbore and extends to the seafloor;
   c. The abandoned well is in an area of sediment instability such as mud flows, slumps, and slides.
2. All perforations open to the producing formation(s) should be squeezed with cement.
3. All plugs must be pressure tested as per MMS regulations.
4. Sufficient density fluid should be present in the casing to exert hydrostatic pressure exceeding the greatest formation pressure in the intervals between the plugs at the time of abandonment.
5. The top of the wastes should be at least 1,000 feet below the mudline.
6. Encapsulated wastes should be isolated below from any open annulus by placing a 200-foot-long cement plug between the waste and the open annulus.
7. If the top of the waste is less than 3,000 feet below the mudline, there should be cement covering the casing at all depths above 3,000 feet.
8. A cast iron bridge plug and a 200-foot-long cement plug containing a permanent dye solution should be placed at the top of the wastes.

B. Injection Criteria

1. The disposal reservoir should be depleted of commercial hydrocarbons.
2. The disposal reservoir/formation should be isolated by shale barriers above and below and not contain any producing wells.
3. The disposal reservoir/formation should be below the deepest underground source of drinking water.
4. The wellbore, tubular goods, and control devices should demonstrate mechanical integrity (no tubing/casing communication).
5. Surface tubing and the tubing/casing annulus pressure should be continuously monitored with a two-pen chart recorder during injection.
6. A base-line radioactive tracer log should be run prior to injection and a follow-up log should be run after injection to verify proper placement of the slurry.
7. If the well is to be used for future injections, the following procedures should be followed:
   a. A retrievable plug should be set;
   b. The well should be marked, clearly indicating the well is being used for the injection of wastes and whether the wastes contain NORM.
   c. The tubing and casing pressures should be monitored daily on manned structures and weekly on unmanned structures and mechanical integrity (pressure sealing properties) should be checked annually.

III. WORKER SAFETY GUIDELINES

A. The application should establish to the satisfaction of the District Supervisor the existence of procedures adequate to protect those workers responsible for disposal operations.

B. Any employer of persons engaged in activities involving wastes containing NORM above background levels (including transportation, storage, sampling, mixing, and disposal operations) should comply with the provisions of 29 CFR 1910.96.

C. All onsite contractors directly involved with the handling or disposal of NORM wastes should be trained in the handling of NORM and licensed pursuant to a state program acceptable to the District Supervisor.

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IV. APPLICATION GUIDELINES

A. Disposal Information

All applications should be submitted to the Regional Supervisor for Field Operations and should address the following aspects of the disposal operation:

1. A description of the material to be disposed of including:
   a. Whether the waste is to be formed into a slurry and a description of the medium to be used to form the slurry (e.g., barite/bentonite, saltwater with HEC viscosifier, cement);
   b. The number of containers to be disposed of, a description of the contents of each container (example: a half-filled container of oily produced sand), and of the container itself (a 55-gallon drum, a barrel, PVC pipe, etc.);
   c. A description of any miscellaneous RCRA-exempt material to be disposed of;
   d. The area(s) and block number(s) where the material originated;
   e. If the waste contains NORM above background levels:
      (1) The location(s), if any, where the material had been stored,
      (2) The radiation exposure rate for each container and for background conditions in microrems/hr (see Section VI).
   f. A description or listing of any unusual contaminants that may be present, or of any contaminants having unusually high levels, if known, within the materials to be disposed of; and
   g. Any documentation submitted to a state agency prior to the disposal event.
2. The OCS lease number, area, block number, and well number of the disposal well.
3. The distance in feet of the disposal well from the two nearest lease lines and the latitude and longitude of the disposal well.
4. The disposal technique (i.e., injection, encapsulation, etc.).
5. A description of the procedures for injection or encapsulation (i.e., fracture procedure, plugs to be set, etc.).
6. A schematic of the wellbore prior to encapsulation/injection and the proposed wellbore schematic after encapsulation/injection.
7. An assurance that the worker safety guidelines outlined in Section III will be adhered to.
8. Encapsulation Information
   If any or all of the oil and gas waste is to be encased in tubulars/casing, the application should state:
   a. The size, grade, and weight per foot of the tubular/casing;
   b. The sub-surface depth of both the top and bottom of the tubulars/casing;
   c. Whether the tubulars/casing will be free in the hole or will be secured by cement, a bridge plug, or a cement retainer.
9. Injection Information
   a. A description of any dilution procedures to be used prior to injection.
   b. A structure map of the formation that is to receive the injected slurry.
   c. A 5-inch open hole log showing the injection zone and the shale above and below this zone. The log should contain spontaneous potential or gamma ray and resistivity curves.
   d. The maximum anticipated surface and reservoir injection pressure.
   e. A model simulation of the fracture that will be produced during the injection procedure (i.e., length, height, and width of fracture).
   f. The predicted maximum distance from the wellbore the injected slurry will be placed.
   g. The distance to the nearest fault from the injection zone.

B. Offshore Storage Guidelines

When wastes containing NORM above background levels are to be temporarily stored offshore, applications for storage should be submitted to the Regional Supervisor for Field Operations and should contain the following information:

1. The lease number, area, block, and platform where storage is requested.
2. Whether the platform proposed for storage is a manned or unmanned platform.
3. The number of containers, a description of the containers.

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MMS (continued)

4. For wastes containing NORM above background levels to be stored at the platform, the radiation exposure rate (micro-rems/hr) for each container and for back ground conditions.
5. The length of time requested for storage (not to exceed one year).
6. The method of securig the containers to the platform to avoid loss during severe storms or hurricanes.
7. The height above sea level of the deck(s) on which the storage is to take place.
8. The lease number(s), area(s), and block(s) where the material originated.
9. Similar information for addition contain ers to be stored on the platform should be provided to the Regional Supervisor for Field Operations prior to placement.

V. REPORTING AND RECORDKEEPING

A. All applications for disposal operations should verify that the applicant will submit a report to MMS within 30 days of the disposal describing:
   1. The results of the operation,
   2. A discussion of any problems encountered during the disposal operation,
   3. If the material was disposed of in containers:
      a. The total number of containers,
      b. A description of the wastes in each container,
      c. A description of the containers used.
   4. If the material was disposed as a slurry, the wet weight of the waste slurry.
   5. Radiation Exposure Rate Measurements:
      a. The radiation exposure rate, reported in microrems/hr, obtained from the outside of each container of NORM waste prior to disposal and from the 1-liter sample by placing the sensing element in direct contact with the top or bottom and the four sides of the middle of the container and liter sample;
      b. For solid materials that are an odd size, such as pipe, the radiation expo sure rate readings taken from at least three different accessible points with the highest readings recorded. Pipe exposure rate readings should be taken from the middle and end of the pipe;
      c. The average of each group of measurements for the containers, the liter samples, and/or the odd-sized materials, as well as the highest reading for each group; and
      d. A recorded background reading;
      e. The survey, calibration, and measurement should be performed by trained personnel. The radiation detection instrument should measure gamma radiation, should be capable of measuring 1 microroentgen per hour through 500 microroentgen per hour, and should be calibrated by a qualified person at intervals not to exceed 6 months.

B. For all NORM Storage Operations:
   1. That the operator will maintain records indicating the beginning date of storage; the origin of the stored material and, if applicable, where the material was previously stored; the radiation exposure measurements for each container; and the total number of containers.
   2. That the operator will notify MMS within 30 days when the material is no longer stored at the site.

This NTL is also on Minerals Management Service's worldwide website at http://www.mms.gov. ■

Solvent removes downhole NORM-contaminated $BaSO_4$ scale

W.G.F. Ford, Halliburton Energy Services, Duncan, Oklahoma
L.L. Gadeken, Halliburton Energy Services, Houston, Texas
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For those who may not have seen it, an article with this title by these authors appeared in the April 22, 1996 issue of the Oil and Gas Journal.

A research project in Canada recently demonstrated that a solvent can remove barium sulfate ($BaSo_4$) scale contaminated with NORM from wells. The solvent dissolves the $BaSO_4$ scales, and all radioactive material is left downhole, eliminating costly NORM disposal. ■

EPA Publishes Proposed Guidelines for Carcinogen Risk Assessment

On 23 April, 1996, the U.S. Environmental Protection Agency (EPA) published a document titled ***Proposed Guidelines for Carcinogen Risk Assessment*** (hereafter "Proposed Guidelines"). The notice is 61 FR 17960.

These Proposed Guidelines were developed as part of an interoffice guidelines development program by a Technical Panel of the Risk Assessment Forum within EPA's Office of Research and Development. These Proposed Guidelines are a revision of EPA's 1986 ***Guidelines for Carcinogen Risk Assessment*** (hereafter "1986 cancer guidelines") published on 24 September, 1986 (51 FR 33992).

When final, these guidelines will replace the 1986 guidelines. In a future *Federal Register* notice, the Agency intends to publish for comment how it will implement the Proposed Guidelines once they are finalized.

The plan is to propose and seek comment on how the Guidelines will be used for Agency carcinogen risk assessment and, in particular, will address the impact of the Guidelines on the Agency's existing assessments, and any mechanisms for handling reassessment under finalized Guidelines. The comment period will close on 21 August, 1996. For additional information contact the EPA technical staff at 202-260-7345. ■

Campbell Wells Corporation

Campbell Wells Corporation, a wholly owned subsidiary of Sanifill Inc. began receiving NORM wastes for treatment and disposal in May 1994 at its facility located near Lacassine, Louisiana. The Lacassine facility is designed to treat non-hazardous oilfield waste (NOW) contaminated with naturally occurring radioactive material (NORM). This commercial facility, the first of its kind in the United States, is permitted to receive NOW-NORM generated throughout Louisiana, other states, and the Outer Continental Shelf.

The permits issued to the Lacassine facility by the Louisiana Department of Natural Resources and the Louisiana Department of Environmental Quality (LADEQ) specify that the facility may receive NOW-NORM that contains not more than 200 picocuries of radium per gram (pCi/gm). The waste material will be treated at the Lacassine facility to (i) bring the NOW element of the wastes to the "reusable material" standards as specified in Order 29-B and monitored by the LADEQ, and (ii) reduce the radium content of the NORM wastes to levels that do not exceed 5 pCi/gm above radium background concentrations in the vicinity. This will qualify the treated waste materials for "unrestricted transfer" as defined in the LADEQ's regulations for the control of NORM.

NOW-NORM waste materials containing radium in excess of 200 pCi/gm, other NORM-contaminated oilfield wastes, and NORM-contaminated materials not associated with oilfield wastes may be managed through **Campbell Well's** Sunrise Supply Limited facility. Sunrise Supply is the only LADEQ licensed commercial storage facility in Louisiana. Through the combination of the new Lacassine NORM facility and the Sunrise Supply storage facility, **Campbell Wells** provides the oil and gas industry with a comprehensive program for compliance with NORM regulations.

For additional information on the NORM services provided by **Campbell Wells**, contact:

Sammy Cooper or Jerry Brazzel at (318) 266-7979

RISK DOCUMENT AVAILABLE

Health Risks of Low-Level Ionizing Radiation is now available. This document presents information about health risks from low-level ionizing radiation in a somewhat less technical form than is found in most scientific reports.

The document is also intended as a mechanism for presenting quantitative risk measure which CRCPD endorses as representing reasonable and balanced interpretations of the current stage of scientific knowledge. Risk measure is a generic term used in this document to indicate any quantitative expression of risk.

The membership of CRCPD has a dual purpose in issuing this document. One purpose is to present information about low-level ionizing radiation risk in a form that can be readily understood by the interested yet relatively uninitiated reader. The hope is that this document will assist state radiation control staff and others in developing and presenting risk information to management, legislature and public audiences.

A second purpose is to recognize quantitative measures of risk associated with various categories of ionizing radiation exposure which the membership endorses as reflecting a reasonable and balanced interpretation of the current stage of scientific knowledge.

The cost of this document is $35. To obtain a copy, send your written request and payment (U.S. currency) (check or money order, made out to CRCPD) to CRCPD, 205 Capital Avenue, Frankfort, KY 40601, Attn: Bettye Merriman ■

RADIATION RISK IN PERSPECTIVE

In accordance with current knowledge of radiation health risks, the Health Physics Society recommends against quantitative estimation of health risk below an individual dose of 5 rem in one year or a lifetime dose of 10 rem in addition to background radiation. Risk estimation in this dose range should be strictly qualitative accentuating a range of hypothetical health outcomes with an emphasis on the likely possibility of zero adverse health effects.

The current philosophy of radiation protection is based on the assumption that any radiation dose, no matter how small, may result in human health effects, such as cancer and hereditary genetic damage. There is substantial and convincing scientific evidence for health risks at high dose. Below 10 rem (which includes occupational and environmental exposure), risks of health effects are either too small to be observed or are non-existent.

Current radiation protection standards and practices are based on the premise that any radiation dose, no matter how small, can result in detrimental health effects, such as cancer and genetic damage. Further, it is assumed that these effects are produced in direct proportion to the dose received, i.e., doubling the radiation dose results in a doubling of the effect. These two assumptions lead to a dose-response relationship, often referred to as the linear, no-threshold model, for estimating health effects at radiation dose levels of interest.

There is, however, substantial scientific evidence that this model is an oversimplification of the dose-response relationship and results in an overestimation of health risks in the low dose range. Biological mechanisms including cellular repair of radiation injury, which are not accounted for by the linear, no-threshold model, reduce the likelihood of cancers and genetic effects.

Radiogenic Health Effects Have Not Been Observed Below 10 Rem

Radiogenic health effects (primarily cancer) are observed in humans only at doses in excess of 10 rem delivered at high dose rates. Below this dose, estimation of adverse health effects is speculative. Risk estimates that are used to predict health effects in exposed individuals or populations are based on epidemiological studies of well-defined populations (e.g., the Japanese survivors of the atomic bombings in 1945 and medical patients) exposed to relatively high doses delivered at high dose rates. Epidemiological studies have not demonstrated adverse health effects in individuals exposed to small doses (less than 10 rem) delivered in a period of many years.

Limit Quantitative Risk Assessment to Doses at or Above 5 Rem Year or 10 Rem Lifetime

In view of the above, the Health Physics Society has concluded that estimates of risk should be limited to individuals receiving a dose of at least 5 rem in one year or a lifetime dose of at least 10 rem in addition to natural background. Below these doses, risk estimates should not be used; expressions of risk should only be qualitative emphasizing the inability to detect any increased health detriment (i.e., zero health effects is the most likely outcome).

Impact On Radiation Protection

Limiting the use of quantitative risk assessment, as described above, has the following implication for radiation protection:

(a) The possibility that health effects might occur at small doses should not be entirely discounted. Consequently, risk assessment at low doses should focus on establishing a range of health outcomes in the dose range of interest including the possibility of zero health effects.

(b) Collective dose (the sum of individual doses in an exposed population expressed as person-rem) remains a useful index for quantifying dose in large populations and in comparing the magnitude of exposures from different radiation sources. However, for a population in which all individuals receive lifetime doses of less than 10 rem above background, collective dose is a highly speculative and uncertain measure of risk and should not be quantified for the purposes of estimating population health risks. ■

An EPA Response to Position Statement of the Health Physics

The following article is reproduced here with the permission of Dr. Jerome Puskin, Office of Radiation and Indoor Air, U.S. Environmental Protection Agency. The article was first published in the ***Health Physics Society Newsletter***, May 1996. Dr. Puskin slightly revised the HPS Newsletter article for publication here.

The Health Physics Society (HPS) position statement "Radiation Risk in Perspective" (Mossman et al 96) dismisses the traditional reliance in radiation protection on the linear, non-threshold model and recommends that risks not be quantified at low doses. It is EPA's view that the HPS statement is deficient in scientific justification and clarity and that the substance of the statement sharply conflicts with recommendations from consensus committees established by such prestigious national and international organizations as the National Radiation Protection and Measurements (NCRP), the National Academy of Science (NAS), the International Commission of Radiological Protection (ICRP), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and the National Radiological Protection Board of the U.K. (NRPB). Implementation of the HPS recommendation would be unacceptable to exposed workers in members of the public and would effectively remove much of the basis for rational decision making about radiation protection.

The HPS paper states that, below 10 rem, risks of health effects are either too small to be observed or are non-existent. This neglects the epidemiological evidence for childhood cancer induction by *in utero* doses as low as 1-2 rem. For chronic dose rates of the order of natural background, direct evidence of human health effects from low dose irradiation is indeed lacking. Given statistical and other methodological limitations to epidemiology, this may always be the case. There are, nevertheless, strong reasons for believing that low-dose radiation can increase the risk of cancer and that the risk per unit dose at low dose and dose rates is not dramatically lower than what is observed in populations receiving an acute high dose exposure.

It is widely accepted that carcinogenesis is a multistage process in which a single cell gives rise to a tumor with mutation of the cellular DNA required in one or more of the steps leading to malignancy. Since cancer is a common disease, obviously the background rate for each of these steps is not zero and any filtration mechanism for removing precancerous cells is imperfect. Consequently, any exposure increasing the rate of somatic mutations would be expected to increase the risk of cancer. There is compelling evidence that radiation is mutagenic down to the lowest doses (UNSCEAR, 1993). It appears that clusters of ionization generated by even a single electron track are capable of producing DNA damage that is not always faithfully repaired, Therefore, the existence of repair does <u>not</u> imply a threshold, or even a nonlinearity in the dose response at low doses.

It is reasonable to expect nonlinearity at sufficiently high doses and dose rates where repair mechanisms maybe overwhelmed by the extent and the complexity of the DNA damage. However, human epidemiological data indicate approximate linearity in the dose response for solid tumors; consequently, there is no basis for expecting a large reduction in the risk per unit dose at lower doses in humans. An in-depth review of the influences of dose and dose rate on stochastic effects of radiation has been conducted by UNSCEAR, which concluded that the risk per unit dose may be reduced for doses below 20 rad or dose rates below 0.01 rads per minute, but that the adjustment in humans appears to be quite low: about 2 for leukemia and approximately 1 for most solid tumors (UNSCEAR 1993).

UNSCEAR has also recently reviewed the evidence pertaining to a possible beneficial effect of radiation at low doses (UNSCEAR 1994). Although the UNSCEAR committee found evidence for a protective effect ("adaptive response") of low- dose radiation in some cellular systems, likely resulting from induction of a DNA repair process, they found that: "[t]he presence of an adaptive response is not readily evident from the results of experiments in mammalian organisms in terms of reduced tumour induction. The low statistical power of the epidemiology studies also prevents a clear statement on the presence of an adaptive response in humans exposed to low doses." Thus, the significance of the adaptive response in cell preparations to human risk estimation is highly speculative. The UNSCEAR report states that "it would be premature to conclude that cellular adaptive responses could convey possible beneficial effects to the organism that would outweigh the detrimental effects of exposure."

Another incisive review of the low dose issue has been published by

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An EPA Response (cont'd)

the NRPB (NRPB 1995). Their conclusions, are diametrically opposed to the HPS position:

...data relating to the role of gene mutations in tumorigenesis, the monoclonal origin of tumors, and the relationship between DNA damage repair, gene/chromosomal mutation and neoplasia are well established and broadly consistent with the thesis that, at low doses and low dose rates, the risk of induced neoplasia rises as a simple function of dose and does not have a DNA damage or DNA repair related threshold-like component. Whilst adaptive responses or other protective mechanisms may influence the risk of tumour development, they do not provide a sound basis for judgment that tumorigenic response at low doses and low dose rates of radiation is likely to have a non-linear component which might result in a dose threshold below which the risk may approach zero. These mechanistic studies, in addition to the epidemiological information, indicate that for radiation protection purposes there is little basis for arguing that low radiation doses (about 10 mGy [1 rad]) would have no associated cancer risk and that, in the present state of knowledge it is appropriate to assume an increasing risk with increasing dose.

The HPS position also suffers from imprecision in language and apparent internal inconsistencies. On the one hand, it recommends risks not be quantified at low doses; on the other, it acknowledges "[t]he possibility of health effects at small doses should not be entirely discounted..." and recommends that "risk assessment at low doses should focus on establishing a range of health outcomes in the dose range of interest including the possibility of zero health effects." It is unclear how one establishes such a range without quantifying the potential risk. Another point of confusion is that, in places, the HPS papers seems only to suggest that, because epidemiological studies lack power in the low dose region, we cannot confidently estimate risks there, but elsewhere it makes the somewhat ambiguous claim that, for low doses, "zero effects is the most likely outcome," which would seem to imply strong evidence for a threshold.

A major use of collective dose calculations is to provide a measure of benefits (from dose reduction measures) that can be weighed against costs. Dispensing with the collective dose measure would undermine the use of cost-benefits (ALARA) considerations in radiation protection. According to the HPS approach, a 9-rem lifetime dose to each of 100,000 people is no worse than the same dose to a single person. The NCRP recently published an evaluation of the collective dose issue (NCRP 1995) and drew conclusions opposite to those of the HPS. The NCRP recommended that all doses be included in collective dose calculations, *no matter how small.*

It is the EPA position that, so long as the uncertainties are properly assessed and communicated, quantitative risk estimates at low doses serve a legitimate role in deciding policy and in providing perspective for the public.

References

K.L. Mossman, M. Goldman, F.X. Masse, W.A. Mills, K.J. Schiager and R.J. Vetter. ***Radiation Risk in Perspective,"*** Health Physics Society Newsletter 24(3), 3, 1996.

National Council on Radiation Protection and Measurements. Principles and Application of ***Collective Dose in Radiation Protection.*** Report No. 121. NCRP, Bethesda, MD, 1995.

National Radiological Protection Board. ***Risk of Radiation-induced Cancer at Low Doses and Low Dose Rates for Radiation Protection Purposes.*** NRPB, Chilton, Didcot, Oxon OX11 ORQ, 1995.

United Nations Scientific Committee on the Effects of Atomic Radiation. ***Sources and Effects of Ionizing Radiation. UNSCEAR 1993 Report to the General Assembly. United Nations, NY; 1993 Report to the General Assembly.*** United Nations, NY; 1993.

United Nations Scientific Committee on the Effects of Atomic Radiation. ***Sources and Effects of Ionizing Radiation. UNSCEAR 1994 Report to the General Assembly.*** United Nations, NY, 1994. ■

WHOA IS ME!

Mary Walchuk

My editor's unhappy,
Says I'm not doing well.
"Your writing is quite snappy
But I'm afraid you just can't spell!"

So I went to the computer store
And bought a word processor.
I'll use spell check evermore;
I'm really going to impress her.

Now I'll keep my job I'm sure;
From know on win I right
Every single little word
Is going too bee spilled write! ■

"Why does a slight tax increase cost you $200 and a substantial tax cut save you 30 cents?"

---Peg Bracken, 1969

FRENCH ACADEMY OF SCIENCES RECOMMENDATIONS ON ICRP 60

The following appeared in the January 1996 issue of the *Canadian Radiation Protection Association Bulletin.*

"In February 1995, the French Minister of Health, Philippe Douste-Blazy, asked the Academie des Sciences for its recommendations following the publication of ICRP Report No. 60. A working group chaired by Permanent Secretary Francois Gros (former director of the Institute Pasteur and world-renowned biologist), examined the ICRP's arguments, which are based on recent progress in cellular and molecular biology and on its latest epidemiological data.

'At the end of this review, the Academic concludes that:

1) There is no scientific basis to support a reduction to 1 mSv/year for the public in France.

2) There are no indisputable, recent scientific facts to support a reduction of the standards currently in force in France for workers. The conclusions of 1989 (Academic) report are unchanged with respect to the lifetime dose of 1,000 mSv, which implies follow-up every 10 years to ensure that the dose rate is consistent with the target.

3) New contributions from molecular biology suggest that the induction process of persistent genome lesions that might cause cancer differs significantly at low and high dose rates. These differences are due mainly to DNA repair mechanisms, which are not identical in the two situations. Recent epidemiological data entirely support this conclusion.

4) Medical examinations are the second largest source of public exposure after natural radiation exposures from other sources produce smaller doses. To significantly reduce public exposure, emphasis should be placed on reducing doses during radiological examinations, especially for young people.

5) Encouragement should be given to present and future research on the biological effects of ionizing radiation, the development of new sensitive methods of detecting the effects of radiation on the human genome, and the epidemiology of low doses of radiation.

6) A small minority among the members of the

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FRENCH ACADEMY OF SCIENCES RECOMMENDATIONS ON ICRP 60

(Continued)

group, while in overall agreement with the first recommendation, (feeling that the reduction of dose limits for the public in the ICRP's new proposals is difficult to justify on the basis of the arguments presented), nonetheless believes that France should not dissociate itself from the positions taken by other countries. This small minority disagrees with Recommendation 2 on standards for workers. While in agreement with the proposal for a lifetime dose of 1,000 mSv, it prefers individual follow-up, including employees who change jobs, to verify that the dose received over five years does not exceed 100 mSv. For those two reasons, some members of this minority would prefer to provisionally accept all the dose limits proposed by the ICRP (public and workers), with the possibility of raising standards for the public in the future on the basis of developments in radiology and radiopathology. Within this same minority, others advocate adopting the ICRP proposals only for workers, and therefore support the majority recommendations concerning recommendation 1.

Information: Teledoc, 11, rue Lavoisier, F75738 Paris Cedex 08, France. ■

What, sir? You would make a ship sail against the wind and currents by lighting a bonfire under her deck? I pray you, excuse me. I have no time to listen to such nonsense.

Napoleon Bonaparte, speaking to Robert Fulton, American inventer

NCRP Committee to Evaluate Linear, No-Threshold Dose Response Model

The National Council on Radiation Protection and Measurement (NCRP) announced the formation of Scientific Committee 1-6 to evaluate the linear, no-threshold dose model.

The Committee is chaired by Arthur Upton and has the following members: James Adelstein, David Brenner, Kelly Clifton, Stuart Finch, Eric Hall, Amy Kronenberg, Howard Liber, Robert Painter, Julian Preston, Roy Shore, and William Beckner (NCRP staff).

At the Committee's first meeting on 25 January 1996, the group accepted the charge from NCRP president Charlie Meinhold, decided to publish an invitation for new data, agreed on topics to be addressed in the report, agreed to prepare a preliminary outline of topics to be covered, and initiated drafting of the reported outline.

The Committee continued discussions in a conference call on 12 March and met again on 30 May. The report is expected to be complete in about two years.

The preliminary outline for the report follows:

* Introductions
* DNA Lesions Induced by Radiation
* Mutagenic Effects
* Chromosome Aberrations
* Oncogenic Transformations *In Vitro*
* Carcinogenic Effects in Animals
* Carcinogenic Effects in Human Populations
* Adaptive Processes
* Conclusions ■

New Subscription Rates

The cost of subscriptions to The NORM Report will increase July 1, 1996. The new one-year rates will be $115 ($59 for government and non-profit organizations).

This is the first increase since I have charged for the newsletter and is necessary due to the sharply increased costs of publishing The NORM Report.

The following is an abstract of a paper presented to the American Academy of Health Physics 1995 Radiology Centennial by Ronald L. Kathren

Pathway to a Paradigm: The Linear Nonthreshold Dose Response Model in Historical Context. The American Academy of Health Physics 1995 Radiology Centennial Hartman Oration

Ronald L. Kathren

Abstract--This paper traces the evolution of the linear nonthreshold dose-response model and its acceptance as a paradigm in radiation protection practice and risk analysis. Deterministic effects such as skin burns and even deep tissue trauma were associated with excessive exposure to x-rays shortly after their discovery, and carcinogenicity was observed as early as 1902. Still, it was not until 1925 that the first protective limits were suggested. For three decades these limits were based on the concept of a tolerance dose which, if not exceeded, would result in no demonstrable harm to the individual and implicitly assumed a threshold dose below which radiation effects would be absent. After World War II, largely because of genetic concerns related to atmospheric weapons testing, radiation protection dose limits were expressed in terms of a risk based maximum permissible dose which clearly implied no threshold, was an important underpinning of the standards. The linear nonthreshold dose-response model was originally used to provide an upper limit estimate of the risk, with zero being the lower limit, of low level irradiation since the dose-response curve could not be determined at low dose levels. Evidence to the contrary such as hormesis and the classic studies of the radium dial painters notwithstanding, the linear nonthreshold model gained greater acceptance and in the centennial year of the discovery of x-rays stands as a paradigm although serious questions are beginning to be raised regarding its general applicability. The work includes a brief digression describing the work of x-ray protection pioneer William Rollins and concludes with a recommendation for application of a *de minimis* dose level in radiation protection. ■

The world is governed by opinion.

Thomas Hobbes(1588-1679)

CIRMS Holds Fourth Annual Meeting at NIST

The Council on Ionizing Radiation Measurements and Standards (CIRMS) held its fourth annual meeting at NIST on 28-30 November 1995. The organization represents thousands of users of ionizing radiation and radioactive sources engaged in industrial radiation processing and sterilization, medical radiation diagnostics and therapy, nuclear power, and environmental and worker protection programs. CIRMS provides a forum for discussing ionizing radiation issues; identifying, defining and prioritizing needed work; disseminating information on standards; and organizing workshops and meetings to advance ionizing radiation technology. Over 100 participants attended the meeting, which highlighted advanced techniques in radiation dosimetry and radioactivity measurements for the different ionizing radiation communities. Representatives attended from 28 corporations, 10 federal agencies, 8 national laboratories, 12 universities, and 1 state agency.

Advanced techniques and future measurement needs were discussed in four areas: Radiation Effects, Medical Applications, Public and Environmental Radiation Protection, and Occupational Radiation Protection. An additional session was added to this annual meeting on the implementation for ISO 9000 guidance for those CIRMS members involved in instrument and product manufacturing, and those providing radiation measurement services. The plenary lecture in this session was given by Peter Heydemann, Director of NIST Technology Services. The participation this year was particularly high from the secondary calibration laboratories in the different fields and from small businesses involved in radiation detection instrument manufacturing, as CIRMS provides a forum for these groups to discuss directions for new programs and instrument needs.

For additional information about CIRMS, and to obtain membership applications, please contact Katy Nardi via any of the following methods:

e-mail: katynardi$@aol.com
phone: 301-840-1812
mail: CIRMS
P.O. Bov3418
Gaithersburg, MD 20885-3814 ■

The EPA now selectively regulates ionizing radiation at 10 mrem per year even though background is about 300 mrem per year

IRPA Congress in Vienna

The Ninth Congress of the International Radiation Protection Association (IRPA) convened in Vienna, Austria, April 14-19, 1996, organized by the Austrian Association for Radiation Protection. Reported participants were nearly 1400 from 60 counties with more than 100 from the U.S. Through the efforts of IRPA about 300 scientists from countries of Eastern Europe and the former Soviet Union attended, bringing greater international flavor to the Congress.

Congratulations are certainly in order for the Congress organizers, directed by Prof. Klaus Duftschmid, and for the international program committee, chaired by Dr. Herwig Paretzke, that included Ken Kase and Dave Sliney from the U.S. The organizers excelled in their management of meeting arrangements and in providing opportunities for participants and guests to enjoy the history and culture of old and new Vienna. Entering the magnificent meeting hall to the sound of a brass ensemble was a nice touch, and seeing the "white horses" at the Spanish Riding School and Hearing (but not seeing) the Vienna Boys Choir was "lovely." The Congress' night out was a feast!

The scientific and technical program was well planned to integrate topical symposia and poster presentations on radiation protection issues of worldwide interest. Presentations were informative and oral discussions from the floor were lively, but at times became lectures. Special attention was given to recent findings on the incidence of thyroid cancer is troublesome, the finding of no increase in leukemia and other solid tumors, as yet, is encouraging. Comparing results from these studies, involving protracted exposures to radionuclide with specific organ targets, to findings of cancer in the A-bomb survivors, exposed to instantaneous external radiation, should be a high priority in radiation research. However, ultimately, the answer to radiation risk of cancer lies in understanding the etiology of cancer at the molecular level. Risk of lung cancer from radon daughters remains best assessed by exposure levels and not by assuming values for WR and WT applied to risk coefficients derived from study of the A-bomb survivors. ■

Environmental law violations that a company discovers through its own internal checks and then corrects and reports to the Environmental Protection Agency will get reduced fines under established policy. *Catch*: The EPA insists that the audits that reveal the violations are ***not*** privileged,and the government has the right to reviw them. ■

MEETING CALENDAR

The following is a listing of meetings that may be of interest. These meetings either contain sessions or papers dealing with NORM, or they are of a related subject matter. It is intended to make the Meeting Calendar a regular feature of **The NORM Report**. I would very much appreciate receiving notices of upcoming meetings.

Health Physics Society
41st Annual Meeting
Washington State Convention Center
Seattle, Washington
July 21-25, 1996

This is the Joint Annual Meeting of the Health Physics Society and the American Association of Physicists in Medicine. There will be several NORM papers included in the meeting.

Additional information can be obtained from:
HPS Secretariat
1313 Dolley Madison Blvd.
Suite 402
McLean, VA 22101
Phone: (7030 790-1745
Fax: (703) 790-2672
Email: hpsburkmgt@aol.com

International Conference on Deep Disposal of Radioactive Wastes
Winnipeg, Manitoba, Canada
September 15-18, 1996

For information: M.M. Ohio, Conf. Chair
Waste Management and Environmental Affairs Div.
Canadian Nuclear Society c/o AECL
Pinawa, Manitoba, Canada., ROE 1L0

The 3rd International Petroleum EnvironmentalConference
Albuquerque Hilton
Albuquerque, New Mexico

(Continued on page 24)

MEETING CALENDAR (continued)

September 24-27,1996

A common objective of the conference and the Department of Energy is to seek solutions to environmental issues of a technical, legal, and regulatory nature.

In a recent study, the National Petroleum Council recommended that the Federal Government should use the most up-to-date scientific and technical information available in the legislative, regulatory, and judicial processes. The Council further observed that there is a lack of coordination among federal agencies in developing regulations. This may result in overlapping paperwork requirements on industry with no commensurate increase in environmental protection. The conference will focus primarily on promoting effective technologies which enhance industry's ability to prevent pollution and remediate existing condtions, while providing a sound scientific basis for environmental regulations and policy.

The Department of Energy will be conducting two interactive workshops to address potential solutions to **Overlapping Environmental Regulations** and **Alternatives to Litigation on Issues of Environmental Compliance**. These workshops will offer an opportunity for senior officials from the U.S. Environmental Protection Agency and State Regulatory Agencies to meet with you and discuss possible solutions to these national concerns. For information regarding conference context, contact:

Dr. Kerry Sublette:
The University of Tulsa
Department of Chemical Engineering
600 South College Avenue
Tulsa, OK 74101
Phone: (918) 631-3085
Fax: (918)631-3268

E Mail: CHE_KLS@CENTUM.UTULSA.EDU

(Continued on page 25)

MEETING CALENDAR (continued)

The Fourth Annual Beneficial Reuse Conference BR'96
University of Tennessee Conference Center
Knoxville, Tennessee
October 22-24,1996

The focus of the fourth annual **Beneficial Reuse Conference,** BR'96, will continue to be on radioactivity in scrap metal, but sessions on Department of Energy (DOE) plans to reindustrialize certain facilities, and reuse of concrete are new this year. A tour of Oak Ridge Facilities is planned for the Monday preceding the conference. Another feature is that a one-day session will be devoted to Naturally Occurring Radioactive Materials (NORM). Other topics covered by this year's conference include radioactive scrap al regulations and policy, business/environmental strategies, beneficial reuse initiatives in DOE facilities stakeholder involvement, risk communications and a session hosted by the Association of Radioactive Metal Recyclers (ARMR).

Early registration will result in a substantial discount. Before July 31,1996, the registration fee is $250; after that it is $295. For more information, or to register, call (423) 974-4251 and for BR'96 information E-mail questions to Louis Allen, lallen1@utk.edu

Second International Symposium on Extraction and Minimization of Waste
Scottsdale, Arizona, USA
October 27-30, 1996

Eighteen different societies throughout the world, including the Health Physics Society, are sponsoring this four-day symposium. The international symposium will focus on issues and processing as applied to

(Continued on page 26)

Meeting Calendar (Continued)

the treatment and minimization of wastes. The symposium is expected to bring together a diverse group of researchers, policy makers, regulators, manufacturers and other interested groups to address common interts in waste treatment and minimization.

The following technical topics will be discussed.

* Mining wastes
* Iron and steel industry wastes
* Titanium industry wastes
* Radioactive wastes
* Aqueous processing
*Thermal processing
* Biotreatment
*Treatment of soils
* Smelter and refinery wastes
*Arsenic, selenium, & mercury wastes

For information:
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Fax: (906)487-2934
E-mail: cnesbitt@mtu.edu

Energy Week
Conference & Exhibition
George R. Brown Convention Center
Houston, Texas
January 28-30, 1997

The American Petroleum Institute and the American Society of Mechanical Engineers - Petroleum Division '97 Conference & Exhibition. As organizing sponsors of this 8th Annual International Event, both the API and the ASME are seeking papers related to the business, regulatory and technological changes affecting the oil, gas and petroleum industries.

For more information, please contact:
Rebecca Sellers at (713) 963-6255

Environmental Conference '97
SPE/EPA Exploration & Production
Dallas, Texas U.S.A
3-5 March 1997

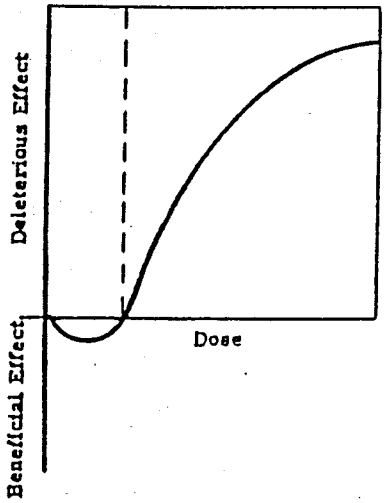
The Society of Petroleum Engineers (SPE) will sponsor the third SPE/EPA Exploration and Production Environmental Conference in March 1997. Several on is issuing a call for participation at the Energy Week major engineering, scientific, oil and gas industry, and governmental organizations endorse this comprehensive conference focusing on U.S.A. exploration, drilling, and production areas. Emphasis will be on industry and government working together to address environmental issues and regulations affecting all oil and gas operations.

The program will feature keynote presentations on the conference theme of **"Environmental Leadership Through Technology."**

For more information, please call:
Society of Petroleum Engineers
Technology Transfer Department
222 Palisades Creek Drive
Richardson, TX 75080
or
P.O. Box 833836
Richardson, TX 75083-3836,. U.S.A. ■

A Graphical Expression of Hormesis

The figure below is provided for the benefit of those health physicists who desire guidance on how to express in graphical form the concept of hormesis. It was published in: Parker, H.M. ***"Radiation Protection Standards: Theory and Application,"*** Atomic Energy Law Journal, Vol. 2, No. 4, pages 334-370 (Fall 1960).



Interestingly, the curve also has bearing on the current discussions related to the linear, no-threshold hypothesis. ■

Scottsdale Radon Panel

The Health Physics Society Radon Section hosted a panel on radon health risks at the 1996 HPS Midyear meeting with presentations by Raymond Johnson, William Mills, and Naomi Harley.

Johnson discussed "Why Some Scientists and the Public Do Not Believe in Radon Risks." It was suggested that most of the radon risk controversy is about the estimates of effects for radon exposures at levels found in homes. Such estimates rely upon linear extrapolations from observed lung cancer incidence in miners. Risk coefficients derived from miner studies, adjusted for differences between miner exposures and home exposures, are then multiplied by the estimated population exposure to estimate population risks. For example, EPA has determined that lifetime exposure to a million person-WLM y^{-1} should result in 224 lung cancer deaths a year. When multiplied by the estimated U.S. exposure of 62 million person-WLM y^{-1}, the radon risk in the U.S. is estimated at 14,000 lung cancer deaths y^{-1}.

Radon risks are not easily understood by the general public and most people are not too concerned about radon unless that they are buying a home. In light of the uncertainties on radon risk, what should the public be told? It was concluded that the prudent public health message should continue to be "test your home for radon and mitigate if the levels are above 4 pCi per liter" according to EPA and State protocols."

Bill Mills described the origins of the radon action level at 4 pCi L^{-1} (150 Bq m^{-3}). He noted that the 1970 Surgeon General's guidelines called for remediation for radon above 0.05 WL. Remediation was indicated for levels between 0.01 to 0.05 WL and no action was recommended below 0.01 WL. When these guidelines were implemented in Colorado, the decision was made for remediation at 0.01 Wl above background. Thus the action level of 0.02 WL (4 pCi L^{-1}) was derived. It was concluded that 4 pCi L^{-1} is too low.

Naomi Harley discussed the limitations with epidemiology studies of miners. She noted that risk models derived from such studies usually overestimate risks. She emphasized that some miner cohorts are outliers and should not be used. She felt that the Colorado miner cohort still represented the best data with a relative risk of about 0.004 WLM^{-1}.

Naomi gave a dose conversion factor of 1 mSv y^{-1} for 1 pCi l^{-1} (37 Bq m^{-3}) and noted that this corresponds to the current population dose limit of 1 mSv y^{-1}. She noted that, at the current occupational limit, 4 WLM y^{-1} for 30 years give 120 CWLM. At 4-8 pCi L^{-1}, exposures in homes would give about 1-2 WLM y^{-1} or 30-60 CWLM for 30 years. She reported that the latest NCRP risk assessment at 1-2 WLM y^{-1} is expected to result in a 1-6 percent increase in lifetime lung cancer risk

Audience Response

Otta Raabe asked for a show of hands on how many believed that radon caused more than 10,000 lung cancer deaths a year in the U.S. No one raised a hand. Most of the audience voted for a number less than 1,000. This response was interesting as an indication of radon risk perceptions among HPs. Naomi indicated that the estimate of 14,000 lung cancer deaths y^{-1} may be overestimated by 2-3X. Johnson asked if HPs should ignore radon if the real risks are only a 1000 y^{-1}? He also asked, if we agree that radon is the largest source of radiation dose at 1-2 mSv y^{-1}, how can we discount radon risks and still justify our jobs as HPs when we are implementing ALARA programs to protect workers at a few tenths of a mSv y^{-1}.

Ken Mossman said that our message to the public should be "stop smoking." Naomi said the HPS should focus on radon, but note that smoking and radon greatly increase lung cancer risk. One HP indicated that public funds would be better spent on promoting child immunization. He received a large round of applause. ■

We Live in a Sea of Radiation

Numbers clearly show that, in spite of man-made sources and the accompanying major releases of radioactive materials into the environment, natural background radiation continues to be the dominant source of dose to the world's population. The NRPB "At-a-Glance" publication, titled "Radiation Doses - Maps and Magnitude" (NRPB 1989), provides some fascinating data on just how important this source is. During each hour of the day, about half a million secondary cosmic rays and neutrons penetrate the body of the average person; about 30,000 atoms disintegrate in our lungs; and about 7,000 uranium atoms and 15 million potassium-40 atoms disintegrate inside our bodies! As if this were not enough, during this same period of time an additional 200 million gamma rays from the soil and building materials pass through each of us. There is little doubt that all of us live in a "sea of radiation. ■

Comparison of NORM Rules by State

	Radium Exemption Concentration	Radium Cleanup Standard
AR	5 pCi/g	5/15 pCi/g(3)
CO (proposed)	5 pCi/g	5 pCi/g
GA	5 pCi/g with high radon factor(1) 30 pCi/g with low radon factor(2)	5/15 pCi/g with high radon factor 30/15 pCi/g(4) with low radon factor
LA	5 pCi/g above background	5/15 pCi/g, or 30 pCi/g if the effective dose equivalent to members of the public does not exceed 100 millirem per year
MI (proposed)	5 pCi/g	5/15 pCi/g
MS	5 pCi/g with high radon factor 30 pCi/g with low radon factor	5/15 pCi/g with high radon factor 30 pCi/g with low radon factor
NM	30 pCi/g	30/15 pCi/g
ND	5 pCi/g.	5 pCi/g
NJ	Variable- depending on concentrations and volumes- annual dose less than 15 mrem/yr.	Variable- depending on concentrations and volumes- annual dose less than 15 mrem/yr.
OK (proposed)	30 pCi/g	30/15 pCi/g
OR	5/15 pCi/g	5 pCi/g
SC	5 pCi/g with high radon factor 30 pCi/g with low radon factor	5/15 pCi/g with high radon factor 30/15 pCi/g with low radon factor
TX	5 pCi/g with high radon factor 30 pCi/g with low radon factor	5/15 pCi/g with high radon factor 30/15 pCi/g with low radon factor
CRCPD (proposed)	5 pCi/g	5/15 pCi/g

NOTES

(1) High radon factory is a radon emanation rate greater than 20 pCi per square meter per second

(2) Low radon factory is a radon emanation rate less than 20 pCi per square meter per second.

(3) 5/15 pCi/g of radium of radium in soil, averaged over any 100 square meters and averaged over the first 15 centimeters of soil below the surface.

(4) 30/15 pCi/g is 30 pCi/g of radium in soil, averaged over any 100 square meters and

(Continued on page 29)

NORM Training Course Offered by OGCI & Peter Gray

OGCI (Oil & Gas Consultants International, Inc.), a world leader in petroleum training, has scheduled 2-day training courses in NORM for 1996 and 1997. The course ***NORM Contamination in the Petroleum Industry*** covers all aspects of NORM contamination and its control, including:

- Fundamentals of Radiation
- Fundamentals of NORM
- Radium Contamination
- Radon Contamination
- State & Federal Regulations
- NORM Surveys including Hands-on Training
- Maintenance Procedures
- Disposal of NORM Wastes
- Decontaminations
- Release of Facilities
- Recommended Programs
- Liability and Litigation

This course builds a rigorous and complete foundation for the control of NORM contamination.

This in-depth course is taught by Peter Gray who has a background in nuclear and radiochemistry and 25 years experience in the petroleum industry. Dr. Gray has a Ph.D. in Nuclear Chemistry from the University of California at Berkeley. He took early retirement from Phillips Petroleum Company in 1985 after 25 years with the company. Since 1985, Dr. Gray has been a consultant in NORM. During his tenure with Phillips, Dr. Gray was in charge of the company's NORM control program from the discovery of NORM contamination in natural gas and natural gas liquids in 1971 until his early retirement in 1985. This background uniquely qualifies Dr. Gray as the instructor for the course.-- an instructor who understands the origin of NORM and why it contaminates nearly all petroleum facilities, where the contamination is, how to set up programs that protect employees, company facilities, the environment and the public, how to survey for NORM contamination, the available options for the disposal of NORM wastes, and the Federal and state regulations for the control of NORM.

Peter Gray is the editor/publisher of **The NORM Report,** a newsletter reporting on developments in NORM, including summaries of regulatory activities on the state and Federal level as well as in Canada.

The 1996/97 schedule for the course **NORM Contamination in the Petroleum Industry** is:

Oct. 3-4, 1996 Houston
March 18-19, 1997 Lafayette, LA

For further information about the course, contact Joseph Goetz, OGCI. 1-800-821-5933, or contact Peter Gray, 918-492-5250, for information about the course content. ■

Comparison of NORM Rules by State (Continued)

Exemption for Contaminated Equipment

AR	Concentration limit only (5 pCi/g)	OK	50 μR/hr including background
		OR	5 pCi/g
CO (Proposed)	Concentration limit only (5pCi/g)	SC	50 μR.hr including background
GA	50 μR/hr including background	TX	50 μR/hr including background
LA	50 μR/hr including background	CRCPD (Proposed)	Concentration in dpm
MS	25 μR/hr above background 100 cpm above background		
NM	50 μR/hr including background		

NOTES

Before release for unrestricted use, facilities or equipment contaminated with NORM should not exceed specified contamination limits in dpm/100 sq. centimeters. ■