The NORM Report

Naturally Occurring Radioactive Material Contamination
FALL 99 / WINTER 00

Index

The NORM Report

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Highlights

This issue of **The NORM Report** contains several interesting and informative articles, e.g., European NORM rules (page 17), a report on NORM in the phosphate industry (page 23), and the revision of disposal options allowing landspreading) in Mississippi (page 4).

Regulations for the Control of Naturally Occurring Radioactive Materials - An Update

The status of regulations for the control of NORM contamination is summarized below for 18 states, the Environmental Protection Agency (EPA), the Nuclear Regulatory Commission (NRC), the Department of Transportation (DOT), Canada, and the Conference of Radiation Control Program Directors (CRCPD). NORM contamination is not limited to the petroleum industry and several non-petroleum states are drafting rules for the control of NORM in other industries in their states. The regulatory agencies were contacted during January and February.

The last state to enact NORM regulations was Ohio. Ohio's regulations became effective June 9, 1997, and were summarized in the Spring 97 issue of **The NORM Report**. The New Mexico and South Carolina regulations were summarized in the Summer 1995 issue of **The NORM Report**. Louisiana, Mississippi, Arkansas, Texas and Georgia have previously enacted regulations for the control of NORM. Oregon enacted regulations in January 1990. Although the Oregon regulations were specifically written for control of NORM in zircon sands, the Oregon regulations do apply to all NORM contamination in the state. The Oregon regulations were summarized in the Winter 1996 issue of **The NORM Report**.

There currently are no federal regulations specifically for the control of NORM, although the Environmental Protection Agency appears to be moving in that direction.

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

The status of NORM regulations in 18 states, the federal government, Canada and the CRCPD begins on page 2.

Summaries of State and Federal Regulations for the Control of NORM

ALABAMA

Alabama is looking at the CRCPD recommendations for the control of NORM before finalizing their redraft of the state's proposed NORM regulations. There is no time table for the regulations to be adopted. There has been some interest in plugging and abandoning wells, but there have been no requests from industry for NORM regulations.

ARKANSAS

The Arkansas NORM regulations constitute Section 7 of the ***Arkansas Rules and Regulations for Control of Sources of Ionizing Radiation.*** The revised regulations were summarized in the Fall 96 issue of this newsletter. There are no plans at present to further revise the NORM regulations.

CONNECTICUT

Using **"Guidelines for Disposal of Drinking Water Wastes Containing Radioactivity"**(U.S. Environmental Protection Agency draft, June 1994) and Nuclear Regulatory Commission limits for release of licensed material, the Connecticut Department of Environmental Protection put together its first guidelines for an actual water treatment facility. It will (for the present) continue developing guidelines for other facilities, giving case-by-case guidance. Simply put, the guidance will be to apply NRC discharge limits above background radioactivity. EPA Region I has given preliminary concurrence on this interpretation of EPA's Draft guidance. The thinking on this — "If it came from the ground and nothing was done to enhance it, it can go back into the ground."

FLORIDA

Recommendations of the Florida NORM Advisory Committee (FNAC) Regarding the Adoption of NORM Regulations in Florida was submitted October 14, 1997 to the Advisory Council on Radiation Protection. Since the recommendations of the Committee are indicative of many of the issues confronted by regulators when considering regulations for the control of NORM, a summary of the recommendations was reported in the Winter 98 newsletter and repeated in the Fall 98 issue.

In its continuing effort to characterize TENORM within the state, site visits to oil fields located in southern Florida are continuing. The inspections verified that TENORM concentrations at the sites are minimal. The highest recorded gamma reading was 80 μR/hr, taken at the base of a saltwater storage tank that had been accumulating particulates for at least ten years. No other readings exceeded one-half that total. Analytical sample results are expected to confirm the low radium content of oilfield pipe scales in the South Florida fields. No conclusions have been reached and no report has been issued. The State's intent is to write a comprehensive report on TENORM in Florida.

The report on the program sponsored by the Florida Institute of Phosphate Research to characterize NORM in the phosphate industry is complete and is available. The report ***Evaluation of Exposure to Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) in the Phosphate Industry***, (Although the report is dated July, 1998, it was not available until late in 1999), Publication No. 95-046-155. It is available from:

Florida Institute of Phosphate Research
1855 West Main Street
Bartow, FL 33830
Tel: 941-534-7160

There is no charge for the report.

There is developing concern in Florida about the transportation of radioactive contaminated materials on the public highway system. There appears to be some transport of these materials in violation of the Federal Department of Transportation regulations.

GEORGIA

Georgia's regulations for the control of NORM became effective in October 1994. There have been no changes in the rules since. Revisions to the general rules and regulations for the control of radiation have been drafted and were adopted by the Board. The revisions became effective May 6, 1997. However, there are no changes in the NORM rules in this revision.

ILLINOIS

Illinois has drafted regulations for the control of TENORM based on the November 97 draft of CRCPD Part N. The draft has been circulated in-house. It is planned to have stakeholder meetings during the winter to get their input before publishing it in the Illinois Register.

Some of the delay was caused by the rewrite of licensing requirements in the general radiation regulations. Since the NORM draft rules refers to these licensing regulations, the NORM rules had to be revised as well. The draft is still being revised and is not available yet.

The TENORM regulations will be

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ILLINOIS (continued)
summarized in **The NORM Report** when available.

KENTUCKY

The Kentucky Department of Environmental Protection continues to work on a satisfactory long term disposal site for NORM. In the meantime, remediation activities in the Martha Oilfield are proceeding gradually and continually towards the final phases of the cleanup of the field. Remediated materials are being stored in a temporary site pending the resolution of discussions on long term storage.

Tracts of land are being certified that they meet the remediation requirements worked out with Ashland Oil. In the last month several owners of some of the tracts have been identified and letters sent to them verifying that their land had been satisfactorily remediated.

When the public clamor over the contamination of the Martha Oilfield dies down, consideration will be given to promulgating NORM regulations.

LOUISIANA

There have been no changes or revisions in the Louisiana NORM regulations and none are planned at the present time.

Chem Waste has received approval for the disposal of NORM wastes containing up to 150 pCi/gm. Chem Waste was hoping for a permit to dispose of mixed wastes, but the permit by the Department of Natural Resources was to create a NOW disposal facility within, but separate from, the RCRA facility. There is a cell specifically for NOW material.

US Liquid sites in Louisiana can receive wastes containing less than 30 pCi/gm.

There is nothing new on the pending application for a new NORM disposal well. The DEQ is waiting approval from the Office of Conservation who must approve it as a disposal well.

The number of P&A disposal wells has increased probably due to the high costs of NORM waste disposal.

There is one facility operated by Phillips Services. It is allowed to operate as a commercial facility because during the incineration process used the NORM is diluted. It is required that the incinerator wastes be disposed as incinerator RCRA waste. As long as the NORM wastes contain less than 5 pCi/gm the Department is not concerned about it from a regulatory point.

Chevron has a NORM injection well for their own wastes from a specific cleaning area (that is, a non-commercial facility.) Chevron was refused permission to bring NORM wastes from Chevron facilities in Mississippi for disposal in their Louisiana injection well.

Meetings have been held with the Hazardous Waste Division to discuss the disposal of NORM contaminated mixed wastes in a hazardous waste landfill. One problem is that the hazardous waste disposal regulations in Louisiana prohibit the disposal of RCRA hazardous wastes containing NORM in a hazardous waste landfill.

The Louisiana regulations are based upon federal regulations. There has been some contact with the EPA in an attempt to determine the intent of the federal regulations. Knowing the intent of the federal regulations may suggest some options which can be used for the disposal of the hazardous wastes containing small concentrations of NORM. The federal regulations do allow some radioactivity, e.g. cesium-137, in the wastes to be disposed of in a hazardous waste landfill. Up to 100 picocuries cesium per gram can be disposed of this way.

MICHIGAN

CORRECTION - In the SUMMER 99 issue of The NORM Report it was reported that a radiation reading was detected in the resurvey of petroleum facilities in Michigan The radiation was reported to be **1,800 microrems/hr**. The radiation detected was actually **18,000 microrem/hr** (18 millirem/hr). The radiation was seen at a separator. The 18,000 microrem/hr is about five times the radiation reading previously seen at this equipment.

There have been no changes in the Michigan guidance documents for the control of NORM and although none are planned for the immediate future, the CRCPD's Part N is being closely followed to determine if it should be the basis for future NORM regulations in Michigan.

The Michigan guidelines for disposal in a type 2 municipal solid waste landfill allow up to 50 pCi/gm radium-226 to be disposed. This can be a large cost saving. Analysis has shown that this level shows insignificant radiation risk to the public. There were two instances in late 1999 of contaminated site cleanups (radium-226 contaminated scale) with the contaminated material being disposed of in a type 2 landfill using the guidelines .

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MICHIGAN (continued)
Michigan is resurveying many petroleum sites for NORM contamination. The original surveys had been done in the early 1990s. The resurveys show, in general, that the NORM contamination is greater now than when first surveyed. As reported above in the "Correction", a radiation reading of 18,000 microcuries was seen at a separator! The resurvey radiation was about five times the radiation seen during the first survey. Radioactivity concentrations of radium-226 as high as 150,000 to 200,000 pCi/gram were seen in the resurveyed facilities.□

NORM contamination in paper mills has been reported. It is expected that Michigan paper mills will be surveyed for NORM

MINNESOTA
Minnesota has no regulations for the specific control of NORM; it has regulations for devices that use discrete NARM (e.g. radium-226) as a source of radiation.

Within the next year Minnesota will have permitted four landfills to take low-level NORM wastes. One of the landfills should be permitted in the near future and the other three before the end of 2000. The level of NORM which will be accepted at the landfills is not determined yet.

The level of concern about NORM contamination is increasing as more people learn about NORM contamination. One problem that has arisen is the zircon sands left when foundries go out of business. Allowing these NORM wastes to be disposed in a landfill will make the disposal easier.

In 1998, the Minnesota Department of Health began the process to become an Agreement State with the U.S. Nuclear Regulatory Commission.

MISSISSIPPI
Responsibility for NORM in Mississippi is currently 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). After the petroleum leaves the wellsite the Department of Health has jurisdiction for any NORM contamination.

However, the Mississippi legislature has enacted legislation that gives the Oil and Gas Board jurisdiction over all oil and gas wastes. The Oil and Gas Board's NORM rules which became effective July 1, 1995 assumes jurisdiction only over NORM at the well. The Mississippi State Board of Health Regulations for Control of Radiation, Section 801.N is still in effect. The Division of Radiological Health continues to process licenses from contractors for NORM decontamination at industrial facilities. The attorney for the Department of Health believes that any commercial remediation, etc. will still have to be licensed by the Department.

Although the jurisdictional conflict has not been completely resolved, it has been smoothed out to a degree. If the NORM wastes are generated by E & P activities it is assumed to be under the jurisdiction of the Oil and Gas Board. If the dosage from the NORM reaches a certain level, the Department of Health assumes jurisdiction. The Department of Health does not appear to be disputing this. The Oil and Gas Board has assumed jurisdiction for about 99% of NORM associated with oil and gas.

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 oil field 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 Mississippi.

Revisions made to Rule 69 at the public hearing August 1995 were summarized in the Winter 96 issue of **The NORM Report**.

Rule 69 is being implemented. Oil and gas operators are conducting NORM surveys on all their properties. Over 1,500 survey data have been entered in a computer. Once all the surveys submitted have been put in the data base, it will be determined which oil and gas sites have not submitted survey data.

The data will be analyzed to determine how many sites are over a selected concentration level of NORM contamination. In the absence of a resolution of the jurisdictional dispute between the Department of Health and the Oil and Gas Board, the latter is assuming responsibility for every oil and gas site in the state.

The Oil and Gas Board received a petition to amend statewide Rule 68 to authorize the surface and subsurface landspreading of Naturally Occurring Radioactive Materials (NORM) associated with the exploration and production of oil and gas. The petition was received from the US Oil & Gas Association, Alabama/Mississippi Division. **Rule 68, Disposal of Naturally Occurring Radioactive Materials (NORM) Associated with the Exploration and Production of Oil and Gas** became effective in September, 1994. The original Rule 68 did not

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MISSISSIPPI (continued)
authorize landspreading as a method of NORM disposal.

Special hearings were held before the State Oil and Gas Board of Mississippi commencing on August 18, 1999. At a hearing held September 15, 1999 arguments and closing statements were heard.

(**Editor's Note**: Because of the widespread interest by industry on landspreading disposal of NORM wastes, some of the Oil and Gas Board's thinking on the revisions to Rule 68 are discussed below.)

The Board was particularly impressed with the testimony of Ms. Carol D. Berger, a Certified Health Physicist. Ms. Berger testified on behalf of the Petitioners in support of the proposed amendment to authorize the surface and subsurface landspreading of NORM E & P oilfield wastes. Ms. Berger participated in the drafting of the proposed landspreading provisions to Rule 68, as well as in the preparation of the accompanying Background Document and Technical Basis for Revision of Rule 68.

Ms. Berger testified that it is the position of the Health Physics Society, of which she is a member, that doses of radiation of less than 10,000 millirem, in addition to natural background radiation, pose no detectable increase in health risks to humans. In addition, Ms. Berger testified that the highest possible dose rate of 40 millirem per year through all applicable pathways, as contemplated by the proposed landspreading amendments to Statewide Rule 68, is orders of magnitude lower than the 10,000 millirem radiation level recognized by the Health Physics Society as being free of any demonstrable radiological risks.

Ms. Berger testified that the basis of her calculations of the highest possible dose rate of 40 millirem per year, through all applicable pathways, as contemplated by the proposed landspreading amendments is the hypothetical farm family. This assumes that the hypothetical farm family, including children, lives on a specific piece of property which contains radiation levels equivalent to five (5) picocuries per gram of soil evenly distributed throughout the,entire property area. This calculation. which utilizes the RESRAD computer program, assumes that the hypothetical.farm family spends twelve (I 2) hours per day standing outside the family residence on the property, where they receive no shielding from their residence. This calculation further assumes that the hypothetical farm family drinks only percolated water, that is, rainwater which has gone through the area of radioactivity, and that radium dissolves in water. Furthermore, this calculation assumes that the hypothetical farm family eats only vegetables grown on the property where the radiation is located and that they drink milk and eat meat only from cows which have grazed on the property where the radiation is located. In addition, this calculation assumes that the children of the hypothetical farm family eat approximately 200 milligrams of dirt a day which contains a radiation level of five (5) picocuries per gram. Ms. Berger testified that utilizing these calculations, and taking all of these factors and assumptions into account, the hypothetical farm family would only be exposed to a maximum possible radiation dose of 40 millirem per year. Ms. Berger testified that these radiation levels are orders of magnitude below the radiation levels of 10,000 millirem or less which the Health Physics Society has concluded pose no detectable health risk to humans. The Board found the testimony of Ms. Berger with respect to the maximum radiation levels which may result from the approval of the proposed landspreading amendments to be particularly credible and convincing.

Ms. Berger further testified that no studies have ever demonstrated any adverse health effects on humans at acute radiation doses of less than 10,000 millirem. Ms. Berger testified that, according to the BIER IV Report, which was prepared by the National Research Council, 10 to 20 rem (i.e., 10,000 to 20,000 millirem) of radiation is the lowest level of radiation exposure at which any human health risks can be demonstrated.

Ms. Berger further testified that humans are constantly exposed to radiation merely by virtue of being alive. Radioactive materials are ubiquitous. That is, they exist all around us. Radiation exists in the soil and rocks around us, in every human body, in building materials, in a large number of consumer products, in the food we eat, the air we breathe and in, on and around virtually everything with which humans come in contact. Ms. Berger testified that each citizen of the United States receives on average approximately 360 millirem of radiation each year from all natural and medical sources. She testified that there is no credible scientific evidence which would demonstrate that radiation doses of 360 millirem per year have ever caused any radiation-related health effects. Ms. Berger further testified that in areas of higher attitudes and different geologies, people are exposed to significantly higher levels of naturally occurring radiation. For example, she testified that people living in Leadville, Colorado, are exposed to more than twice the

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MISSISSIPPI (continued)
national average levels of radiation. Ms. Berger testified that there is no evidence of any radiation-related health effects occurring in that portion of the national population which receives twice the annual average radiation dose.

Ms. Berger further testified that certain phosphate fertilizers with broad commercial applicability (i.e., for use in golf courses, home use and commercial applications) contain radium at levels exceeding 20 picocuries per, gram. This concentration is four (4) times higher Than the five (5) picocuries per gram in soil contemplated in the proposed landspreading amendments to Rule 68. Ms. Berger further testified that the United States Environmental Protection Agency ("EPA') has authorized the use of phosphogypsum tailings as a soil amendment containing radiation levels up to 10 picocuries per gram. She testified that these phosphogypsum tailings contain radium of a type similar to that found in NORM E&P oilfield wastes. Ms.Berger also testified that phosphogypsum tailings are more transportable in the environment.

The Board found that the maximum radiation levels contained in the proposed amendments which would authorize the -surface and landspreading4 of NORM E&P oilfield wastes, are significantly more restrictive than the radiation levels contained in Statewide Rule 69 **"Control of Oil Field NORM"** which was approved by the Mississippi State Oil and Gas Board and became effective June 1, 1996, and which has recently been upheld on appeal by the Chancery Court of the First Judicial District of Hinds County, Mississippi. The Board found that existing Statewide Rule 69, among other things, prescribes standards for the clean-up or remediation of property containing NORM E&P oilfield wastes. The Board noted that property for unrestricted use could have a maximum ambient exposure rate of 50 microR per hour which is equivalent to concentrations of thirty (30) picocuries per gram. The Board's own expert, Dr. Vem Rogers, previously testified during the hearing on Statewide Rule 69 that this maximum soil concentration would result in no demonstrable health and safely impact on the residents of the State of Mississippi- The Board found that the proposed amendments to Statewide Rule 68, which were before the Board will allow the surface and subsurface landspreading of NORM E&P oilfield wastes only where the maximum possible NORM concentrations do not exceed five (5) picocuries per gram. The Board found that the proposed landspreading amendments to Statewide Rule 68 contain maximum NORM concentrations which are six (6) times more conservative than the NORM concentrations prescribed in existing Statewide Rule 69. In addition, the Board found that the maximum radiation exposure rate of 40 millirem per year, as proposed is fully supported by the overwhelming weight of the credible scientific testimony as being safe and fully protective of both human health and the environment.

It was noted by the Board that New Mexico allows landspreading at levels up to 30 picocuries per gram, a concentration six times greater than the five picocuries per gram in the proposed amendment and is equivalent or more restrictive than the five picocuries per gram specified in Texas regulations.

The Board also found the testimony of Dr. Tate Thigpen, another expert witness for the Petitioners, particularly persuasive and convincing. Dr. Thigpen testified that no scientific studies have ever demonstrated any observable health effects from radiation doses below 50,000 millirem. Dr. Thigpen testified that a very conservative level of radiation exposure below which adverse health effects are medically insignificant would be in the range of 10,000 to 20,000 millirem. Dr. Thigpen testified that, in his professional opinion, the radiation levels contemplated in the proposed landspreading amendments to the Rule were medically insignificant and posed absolutely no threat and would cause no harm to the health of the citizens of the State of Mississippi.

The Board stated that it had carefully listened to and evaluated the testimony of all of the Contestants' witnesses and found the testimony of Ms. Berger, Dr. Thigpen and Mr. Edwards. all of whom testified in support of the proposed landspreading amendments to Statewide Rule 68, to be far more credible and persuasive.

The Board stated that in developing the landspreading rules, it had been the objective of the Board to develop rules which are sufficiently protective of oilfield workers, the general public and the environment, which do not conflict with existing state or federal regulations, which are technically sound, and which are implementable by those subject to their provisions. The Board was of the opinion and found that the landspreading rules being adopted fully meet all of these objectives.

The Board found however, after careful evaluation, that a number of additional revisions should be incorporated into the proposed landspreading amendments to Statewide Rule 68 which differ sig-

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MISSISSIPPI (continued)
nificantly from the rule as originally proposed. These additional revisions are summarized below.

The Board revised the Rule to provide that no person may dispose oil and gas NORM waste without first obtaining a permit from the Mississippi State Oil and Gas Board

The Board also found that it is necessary to limit the areas in which landspreading may occur. First, on-site landspreading will be limited to the "site of origin" which is defined as that portion of the surface of land reasonably necessary (excluding lease roads) used for the conduct of producing operations of a well. Secondly, off-site landspreading will be limited to surface property in which the Operator owns fee title to the entirety of the surface.

The Board also made the revision to limit subsurface landspreading to six inch layers not to exceed three feet of total blended volume thickness.

Other features of the amended Rule 68 include landspreading shall not be performed with materials that exhibit ambient exposure rates in excess of 600 microR per hour above background. Also landspreading shall not be performed where the general area exposure rate is significantly elevated above background due to the presence of equipment.

Pre- and post-landspreading radiation surveys are required. The survey of the impacted land area shall be performed to demonstrate that the ambient exposure rate at any given point in the impacted area does not exceed eight microR per hour above background.

The effective date of the amended Rule 68 was January 19, 2000.

NEW JERSEY

The comment period for the proposed rule, N.J.A.C. 7:28-12, ***'Remediation Standards for Radioactive Materials"***, closed on September 15, 1999. The NJ Department of Environmental Protection received 12 comment letters. Commenters included the US Nuclear Regulatory, ' Commission, the US Environmental Protection Agency, the US Army Corps of Engineers, members of industry affected by the rule, and environmental groups. The response to comment document and final rule are being prepared.

The proposal, the technical basis document, the spreadsheet that implements the standards, and guidance on conducting characterization and final status surveys, are all available on the Radiation Protection Programs web site: http://www.state.nj.us/dep/rpp/index.

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.

Rule 714, Disposal and Transfer of Regulated NORM for Disposal provides the regulatory framework for the disposal options addressed in the Part 14 NORM regulations. Rule 714 became effective July 15, 1996. Rule 714 was summarized in the Summer 96 issue of **The NORM Report.**

The New Mexico NORM regulations allow for down-hole injection of NORM waste in a company's own wells. However, the Rocky Mountain Board, one of the Low-Level Radioactive Waste regional compacts, considered NORM to be a low-level radioactive waste and subject to their regulations and the Compact refused to give approval for the injection of NORM wastes in private wells in New Mexico.

On June 1, 1998, the Rocky Mountain Low-Level Radioactive Waste Board adopted an amendment to the Board's rules. The change clarifies that NORM waste from oil and gas production within the Rocky Mountain Compact region may be placed in oil and gas wells without the Board's designating such wells as regional facilities. The Board's action followed a public hearing on the matter.

No one has actually requested permission to dispose of NORM down-hole. A few companies in the state who have accumulated NORM wastes under a general license have requested a one year extension for storing the wastes. Most of these NORM wastes will probably eventually be disposed of down-hole.

The guideline document draft for use with the NORM regulations (Appendix A of the regulations) is now available. The guide is entitled ***Appendix A: Regulation Guidelines for the Management of NORM in the Oil and Gas Industry in New Mexico***.

The purpose of the guidance document is to provide guidance to persons involved with facilities or equipment associated with the production of oil and gas and how to conduct screening surveys with portable radiation detectors to identify NORM and to initiate determination of the extent of needed radiation protection controls. The guide is intended for individuals licensed by the New Mexico Environment

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NEW MEXICO (continued)
Department and permitted by the New Mexico Oil Conservation Division. The document is intended to assist general and specific licensees in the proper use, transfer, transport, storage and disposal of regulated NORM.

The guide describes the type and extent of information needed by the New Mexico Radiation Licensing and Registration Section staff to evaluate an application for a specific license for authorization to perform the following commercial services involving NORM contamination:

A. Commercial decontamination of equipment, facilities and land.

B. To perform maintenance on NORM contaminated equip ment.

C. To promote mixing, grinding, or volume reduction of NORM contaminated material in preparation for disposal.

D. To package or encapsulate NORM contaminated materials in preparation for disposal.

E. To provide health physics support for disposal in plugged abandoned wells.

F. Other services as described in the application.

The following regulations apply and should be used in conjunction with the guide:

A. Subpart 1. General Provisions

B. Subpart 3. Licensing of Radioactive Materials

C. Subpart 4. Standards for Protection Against Radiation

D. Subpart 10. Notices, Instructions and Reports to Workers; Inspections

E. Subpart 14. Naturally Occurring Radioactive Material (NORM) in the Oil and Gas Industry

The guide is for general guidance in preparation of the license application and should not be considered as all the information that may be required for a particular application. Nor is it a substitute for the applicant's safety evaluation of the proposed activity. The applicant must ensure that the application correctly and adequately describes the commercial services offered, and the radiation safety measures and procedures to be followed in order to provide adequate protection. For the purposes of this guide, decontamination means deliberate operations to reduce or remove residual NORM contamination from equipment , facilities or land.

On September 28, 1999 a meeting was held with a Texaco (Midland, Texas) employee (and other interested parties) who wanted to discuss some of the requirements of the Guidance Document. The Guidance Document has been out for about 18 months and before it was available the state asked for comments, etc. and received no response. Now Texaco has prepared a forty-page critique (for a 14 page document). Apparently one of Texaco's problems is the requirement to make baseline radiation surveys of contaminated equipment. Texaco does not think surveys should have to be made of equipment while it is being used. Bill Floyd's answer to that is that the surveys are necessary, for example, to verify that posting is, or is not, required for the protection of workers, etc. Depending on the results of the September 28 meeting, the guidance document may be revised.

Discussions have been held with Texaco (Midland, Texas). As a result of these discussions, the New Mexico Radiation Licensing and Registration Program is attempting to prepare a fact sheet for the oil and gas industry which will be easy to read and understand stressing the importance of base-line NORM contamination surveys. Texaco believes base-line surveys are not required by the New Mexico regulations., and a perusal of the regulations shows that such surveys are technically not required. However, Texaco tentatively agreed that such surveys may be of value, particularly to determine posting requirements and potential future liabilities.

Section 1408 of the regulations lists the conditions requiring NORM surveys and base-line surveys are not uniquely specified.

Further discussions will be held with Texaco and other oil and gas industry representatives to resolve these "problems" and the interpretation of the regulations.

Copies of the New Mexico NORM guide are available from:

William M. Floyd
Program Manager
Radiation Licensing &
Registration Program
2044 Galisteo
P.O. Box 28110
Santa Fe, NM 87502
Telephone: (505) 827-1862
FAX: (505) 827-1544

Copies of the State of New Mexico Radiation Protection Regulations (including the NORM rules), are available for $37.50 from:

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New Mexico (continued)
Santa Fe, New Mexico 87505
505-982-8111

OHIO

The revised Ohio regulations for the control of radiation, including NORM and NARM, were summarized in the Spring 97 issue of **The NORM Report.** The regulations were revised to agree with the federal regulations as an initial step in Ohio's application to become an Agreement State. The Agreement State status became effective August 31, 1999.

The Ohio Department of Health and Radiation Control has proposed action to the following:

- 3701:1-38, General Radiation Protection Standards: and
- 3701:77, Low-level Radioactive Waste.

OREGON

There are no new developments regarding NORM regulations in Oregon. Ray Paris, Manager of Radiation Protection Services in the Oregon Department of Human Resources was also the Chairman of CRCPD's NORM Commission that was responsible for writing the final draft of Part N. Oregon is "waiting" for Part N to be completed before revising or writing new NORM rules for the state.

Oregon has NORM regulations entitled ***Regulation and Licensing of Naturally Occurring Radioactive Materials (NORM).*** The rules which became effective in January 1990 are found in the Oregon Administration Rules, Chapter 333, Division 117 - Health Division. The Oregon NORM rules were summarized in the Winter 96 issue of **The NORM Report.**

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 regulations and none are proposed at the present time. Part IX was summarized in the Summer 95 issue of **The NORM Report.**

TEXAS

The Texas Department of Health has jurisdiction for NORM except for the disposal of NORM contaminated wastes. 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 NORM wastes not associated with oil and gas exploration and production.

In April, 1999, the Texas Department of Health (TDH) finalized revisions to 25 Texas Administrative Code, §289.259, ***Licensing of Naturally Occurring Radioactive Material (NORM).*** The revisions include new definitions that support the changes in the rule. Exemptions for oil and gas NORM waste are redefined and exemptions for pipe (tubulars) and other downhole or surface equipment contaminated with NORM are clarified. Specific licensing requirements for spinning pipe gauge operations that perform NORM decontamination and for persons receiving NORM waste from other persons for processing or storage are added. Other minor grammatical changes are made to the section for clarification.

Over the last several years, industry has indicated that they consider "routine maintenance" to be the repair and maintenance of equipment for the purpose of restoring it to its intended use or efficiency, regardless of the presence of oil and gas NORM. Decontamination of equipment contaminated with NORM above the exempt limits may occur incidental to the routine maintenance. The TDH acknowledges that not all routine maintenance activities result in a significant increase in radiation exposure risk. Simple routine maintenance tasks such as replacing or repairing a valve, changing filters, or "pigging" a pipe are such activities.

The wording in the revised rule, "Maintenance that provides a different pathway for exposure than is found in daily operations and that increases the potential for additional exposure is not considered routine," was proposed in order to further define the risk the department is concerned about. In discussions with the industry, the TDH determined that the activity that presents the most concern is vessel entry. The industry considers this to be routine maintenance. However, this is the type of operation that the TDH believes presents a significantly increased risk from an enclosed environment where an inhalation risk (a different pathway for exposure than is found in daily operations) from NORM can be present.

The TDH acknowledges that unlike the employees of a company specifically licensed to perform decontamination, the employees or contractors of a general license would be performing vessel entry on an infrequent basis and thus, the radiation exposure risk is lowered due to a time factor.

The TDH drafted language that will outline radiation safety precautions that must be followed when vessel entry is conducted during the course of routine maintenance, but wishes to seek further input from

(Continued on page 10)

TEXAS (continued)
course of routine maintenance, but wishes to seek further input from the industry on that draft language. However, in order for several of the other revisions of this section supported by commentors to become effective and for the section to be reformatted in Texas Register format, no change to the wording about routine maintenance was made prior to the rule revisions being finalized.

In July, 1999, the TDH held a workshop to explain the revisions to the rule and to get stakeholder input on the draft language about routine maintenance. Over 75 people attended the workshop and the TDH received a good amount of input on the draft language. Staff will be reviewing the input received during the workshop and will develop new draft revisions to 25 TAC §289.259, probably towards the end of the year.

The Texas Railroad Commission's Statewide **Rule 94: Disposal of Oil and Gas NORM Wastes** took effect February 11, 1995. This rule sets forth requirements for the safe disposal of NORM that constitutes, is contained in, or has contaminated oil and gas wastes. Rule 94 was summarized in the Winter 95 issue of The NORM Report.

The Railroad Commission is conducting a survey of randomly-selected 600 oil and gas production sites throughout the State to determine the radioactivity level of various types of oil and gas equipment, including tanks, valves, pumps, and tubulars relative to background. The survey is being performed by the Commission's district offices. The survey results will be used to enhance existing data and will be used in a study to evaluate the effectiveness of the current regulations for the detection, control, and disposal of oil and gas NORM. The study will be completed by December 2000.

The Texas Natural Resource Conservation Commission (TNRCC) will meet with the Texas Radiation Advisory Board on January 29 to discuss disposal of non-petroleum NORM wastes. The Executive Director of the TNRCC recently ordered a stop in the development of NORM regulations for the disposal of these wastes until there is a petition from industry or others for the rules. There is some speculation that the drinking water people may petition for NORM disposal rules in the near future. The Environmental Protection Agency drinking water rules become effective in November, 2000. There are several areas in Texas that currently are not in compliance with radium in drinking water. The removal of the radium will generate NORM wastes which require disposal.

UTAH
NORM is considered to be included in Utah's comprehensive radiation control regulations. No specific NORM regulations have been proposed at the present time in Utah.

There is a proposal for a new NORM and low-level waste disposal facility. Safety-Kleen currently has a hazardous waste facility ten miles north of Envirocare's NORM site and wants to convert one of their industrial waste cells to a low-level NORM cell.

Safety-Kleen recently decided to withdraw their appeal before the Tooele County Commission to receive NORM and other low-level radioactive wastes. Without County approval, the licensing process is halted. Safety-Kleen had pledged 21 million dollars in school aid to the County pending their approval.

FEDERAL ACTIONS

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA is preparing a report to Congress that states the agency's views on the need to revise its guidelines for TENORM in light of the 1999 National Academy of Sciences evaluation (see The NORM Report Winter/Spring 1999 issue). EPA will explain the technical and policy basis for its views and submit the NAS report along with the EPA report. The EPA report is-expected to be sent to Congress later this year.

The agency's current approach to TENORM is to:

- Study and issue individual technical reports on TENORM producing industries to determine what's in the wastes from each industry and how much risk they pose. Rather than issue a single scoping report covering all industries, the agency will focus on TENORM materials from specific sources in a series of separate reports.
- Identify and study existing TENORM sites to assemble a nation-wide view of the problem--where the wastes are, what's in them, and the risks they present. This consists of a variety of field projects that will give EPA more information on the sources, characteristics and risks of TENORM.
- Ultimately develop and provide education and guidance for safely and economically cleaning up and disposing of TENORM wastes.

(Continued on page 11)

EPA (continued)
Accordingly, EPA will not be issuing a revision of the draft report ***Diffuse NORM Wastes- Waste Characterization and Preliminary Risk Assessment*** originally issued in April 1993. Instead, it plans to use some materials in that report plus new information and revised risk analyses in each of its technical reports. The first of those reports will be on TENORM from uranium mining and is expected to be issued in draft this year.

As described in the **Winter 1999/2000 NORM Report**, the agency is currently conducting a number of projects focusing primarily on abandoned mines:

- EPA and the National Park Service have developed a computerized database that will describe existing sources of information about abandoned mine lands in 9 western states (EPA!s Regions 8 and 9, including Indian reservations) This "database of databases" is to be put on the Internet to make it easier to locate information about abandoned mining lands that may present TENORM radiation hazards. The EPA TENORM page is at: http://www.epa.gov/radiation/TENORM.

- EPA and the Navajo Reclamation Department are conducting a project this year in which they will investigate the radiation hazards from abandoned uranium mining lands on the Navajo Reservation. They will test the soil, water, and other aspects of the environment around and under an abandoned open pit uranium mine near Cameron, Arizona to identify the types and levels of contamination. The project team then will recommend ways to clean up the site.

- EPA is working with the multi-agency Colorado Plateau Data Coordination Group Steering Committee to develop a pilot geographic information database on uranium mines and mills, The database will identify and, show the location of active and inactive uranium mines and mills in Colorado and Utah. It also will contain other information about the sites. This is the first step in developing an ecological atlas about the Colorado Plateau for use by the public and federal, state, tribal, academic, and industrial organizations.

- EPA is providing assistance to the Spokane Indian Tribe to evaluate and clean up the radiological hazards in water and soils from the Midnite Mine proposed Superfund site in Washington State. Using a Scanner Van from the agency's Las Vegas laboratory, a survey was conducted in October 1999 of the haul road between the mine and the mill to locate uranium ore spill sites. Sampling of soil and water from the mine is being analyzed by the EPA laboratory in Montgomery, Alabama.

- Using data obtained primarily from state agencies in Arizona, a report on the occurrence of TENORM from copper mines of Arizona was to be made available on the EPA TENORM web site in February 2000. The report provides radionuclide sampling data, though not risk assessments, for the sites.

As part of efforts being conducted by the multi-agency Interagency Steering Committee On Radiation Standards (ISCORS), Sewage Sludge and Incinerator Ash Subcommittee, a survey is currently being conducted by the EPA, NRC, DOE, DOD, and State agencies in looking at TENORM and other radionuclides in sewage sludge and ash from publicly owned sewage treatment facilities. A pilot study of samples from 9 treatment plants' sludge and ash was conducted in 1997 to calibrate laboratory procedures and analyses, and a report on the survey has been made available on the EPA TENORM Internet web site. The survey consists of two parts, a questionnaire and a request for samples of sludge and ash. The questionnaire portion of the survey was sent out to sewage treatment facilities nationally in the summer of 1999. Based on the responses from the questionnaire, information on NORM concentrations and occurrence, as well as NRC licensee distributions, state and federal agency recommendations, and other statistical information on the size and geographic distribution of the sewage treatment facilities, approximately 300 facilities are being asked to provide samples of sludge and ash for laboratory analysis. It is expected that this study will provide information to the agencies on whether there is a need for revising existing procedures for discharge of radionuclides into sewers, or conducting additional sampling to support revisions to regulations on the use and disposition of biosolids (sludge and ash).

(Continued on page 12)

EPA (continued)
Following a meeting of the ISCORS-NORM Subcommittee on September 15, 1999, comments were provided by the member federal agencies on NRC's staff proposed regulatory and legislative changes for oversight of uranium in-situ leaching production facilities and uranium mill tailings impoundments. The comments were being reviewed by NRC at the time of this writing.

EPA's Proposed Radon in Drinking Water Rule

The U.S. Environmental Protection Agency (EPA) published in the Federal Register, on 2 November 1999, proposed new regulations to protect people from exposure to radon. The proposed regulations will provide states flexibility in how to limit the public's exposure to radon by focusing their efforts on the greatest public health risks from radon--those in indoor air--while also reducing the highest risks from radon in drinking water.

The NRC/EPA Sewage Sludge Report

The **Joint NRC/EPA Sewage Sludge Radiological Survey: Survey Design and Test Site Results** report was issued in March 1999 as Report EPA 832-R-99-900.

Contacting EPA About TENORM

If you have questions or comments about EPA's TENORM Program or TENORM in general, or if you would like to request more information, the EPA can be contacted at

TENORM Program
U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
MS 6602J
401 M Street S.W.
Washington, DC 20460
Tel: 202-564-9445
Fax: 202-565-2065

DEPARTMENT OF TRANSPORTATION (DOT)

The U.S. Department of Transportation has issued notice of a proposed rulemaking that would revise 49 CFR to reflect the 1996 changes in the International Atomic Energy Agency standards for transportation of radioactive materials. Among these changes are many new shipping names as well as nuclide-specific values of A1 and A2 limits for normal and special form material, exempt quantity and exempt concentration. The text of the NPRM is on the web at <http://hazmat.dot.gov/rulemake.htm#99_6283>, which offers a link to the text of the proposed rule and tables of data. Comments should be sent to U.S. DOT Docket Management System, 400 7th Street S.W., Washington DC 20590.

DEPARTMENT OF THE INTERIOR, U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey (USGS) recently released a fact sheet entitled ***Naturally Occurring Radioactive Materials (NORM) in Produced Water and Oil-Field Equipment — An Issue for the Energy Industry.***

This fact sheet was prepared as a useful reference to describe some ongoing research by the USGS. The fact sheet is available at the USGS webpage:

http://greenwood.cr.usgs.gov/pub/fact-sheets/fs-0142-99

NUCLEAR REGULATORY COMMISSION (NRC) SECY-99-259

This paper provides staff's initial recommendations for revisions to 10 CFR Part 40. At this time, the staff cannot provide specific recommendations on all issues related to Part 40 because not all the technical support documents are complete. The revised draft of the dose assessment report, ***Systematic Radiological Assessment of Exemptions for Source and Byproduct Materials***, was not issued until December 1999. However, major aspects of a Part 40 revision can be addressed prior to completion of the dose assessments. Further, some dose information can be found in NCRP Reports and similar documents. The paper discusses options for addressing the jurisdictional and technical issues associated with regulating source material now exempt under §40.13(a), and recommends that the NRC address these broad issues after first interacting with other federal agencies and States involved with the regulation of naturally occurring radioactive materials. It recommends that rulemaking be undertaken to revise §40.51(b) to ensure that transfers of source material at concentrations less than the §40.13(a) concentrations by specific licensees, possibly for purposes of decommissioning and decontamination, do not cause undue risks to the public. Finally, the staff recommends that a rulemaking plan be developed for a rule which would primarily improve control of the exempt and general license distribution of source material, making the regulation of source material more like that for byproduct material.

NRC Report NUREG 1717

NUREG 1717: Systematic Radiological Assessment of Exemptions for Source and Byproduct Materials became available December 1999.

ABSTRACT: This report is an assessment of potential radiation doses associated with the current

(Continued on page 13)

NRC (continued)
exemptions for byproduct and source material in Title 10, of the Code of Federal Regulations (CFR). Doses were estimated for the normal life cycle of a particular product or material, covering distribution and transport, intended or expected routine use, and disposal using dose assessment methods consistent with the current requirements in 10 CFR Part 20. In addition, assessments of potential doses due to accidents and misuse were estimated. Also presented is an assessment of potential radiological impacts associated with selected products containing byproduct material which currently may only be used under a general license and may be potential candidates for exemption from licensing requirements.

For any questions about the material in this report, please contact:

Cheryl Trottier
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U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001
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Email: CAT1@nrc.gov

CANADA

CANADIAN GUIDELINES FOR THE MANAGEMENT OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)

(Preprint Version Draft)
Prepared by the Canadian NORM Working Group of the Federal Provincial Territorial Radiation Protection Committee

The preprint version of the Canadian guidelines was released in January 2000. This should be the last draft before the final version is released, tentatively scheduled for May or June of this year.

A few of the tables have been changed in this latest draft but the general principles are the same as the last draft (February 1999). The last draft was discussed in the SUMMER 99 issue of **The NORM Report.**

The Introduction and the Purpose of the Canadian Guidelines are reproduced below.

Introduction

The Canadian Nuclear Safety Commission (CNSC), formerly the Atomic Energy Control Board (AECB), has legislative control of nuclear fuel cycle materials and man-made radionuclides. However, naturally occurring radioactive material (NORM) is exempt from CNSC jurisdiction except for the import, export and transport of the material. Therefore, jurisdiction over use and radiation exposure to NORM rests with each Canadian province and territory.

It has been the practice for companies that encounter challenges associated with naturally occurring radioactive material (NORM) to seek advice on safety procedures from provincial and territorial regulatory agencies. Such advice has been given on an ad hoc basis, leading to inconsistencies in the interpretation and application of radiation safety standards across Canada.

The Federal Provincial Territorial Radiation Protection Committee (FPTRPC), a Canadian intergovernmental committee established to support federal, provincial and territorial radiation protection agencies in carrying out their respective mandates, recognizes that the potential radiation hazards from NORM are the same as those from radioactive materials controlled by the CNSC. The basic principle of these guidelines is that where workers or the public are exposed to additional sources or modes of radiation exposure because of activities involving NORM, the same radiation exposure standards should be applied as for CNSC regulated activities. This applies to situations where NORM is in its natural state and to cases in which the concentration of NORM material has been increased by processing.

However, in practice there may also be situations where existing natural background radiation is significant quite apart from any activities involving the use of NORM. The issue of whether human intervention is required to reduce such natural radiation levels is quite separate from the issues discussed in these guidelines and the reader is referred to ICRP 65 for a discussion of when such intervention might be warranted.

To that end, the Canadian NORM Working Group has, on behalf of the Federal Provincial Territorial Radiation Protection Committee, produced the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM). The Guidelines are an extension of the work done by the Western Canadian Committee on Naturally Occurring Radioactive Materials (NORM) published in August 1995 as the Guidelines for the Handling of Naturally Occurring Radioactive Materials (NORM) in Western Canada. The differences between the Canadian Guidelines and the Western Canadian Guidelines reflect changes in national and international radiation protection practices and consensus standards for NORM classification and management since 1995.

(Continued on page 14)

CANADA (continued)

The Canadian Guidelines set out principles and procedures for the detection, classification, handling and material management of NORM in Canada, and also include guidance for compliance with federal transportation regulations. These guidelines provide the framework for the development of more detailed NORM management practices and guidelines by regulatory authorities, affected industries and specific workplaces. A separate section outlines the basic science of radioactivity and explains the technical terms and concepts that are used throughout the Guidelines. There is also a glossary at the end of the document for quick reference and definitions.

Purpose of the Canadian NORM Guidelines

As NORM is not part of the nuclear fuel cycle, it does not come under the control of the Canadian Nuclear Safety Commission (CNSC), which licenses and controls radioactive materials associated with the nuclear fuel cycle and artificially produced radionuclides. NORM-related activities therefore fall under the jurisdiction of the provinces and territories. This has lead to inconsistent application of radiation protection standards with numerous agencies involved as materials cross regulatory boundaries. For example, transportation of a NORM material for disposal involves:

- Provincial/Territorial Health, Labour and Radiation Regulatory Agencies for worker and public exposure,
- Provincial Environmental Regulatory Agencies for disposal options.
- The Canadian Nuclear Safety Commission for transport of radioactive material.

Accordingly, the Guidelines were developed to:

- ensure adequate control of NORM encountered by affected industries;
- harmonize standards;
- reduce jurisdictional gaps or overlap.

The basic principle of the Guidelines is that persons exposed to NORM should be subject to the same radiation exposure standards that apply to persons exposed to CNSC-regulated radioactive materials. No distinction is made regarding the origin of the radiation, whether it is NORM in its natural state or NORM whose concentration of radioactive material has been increased by processing (Technologically Enhanced NORM or TENORM). However, because of the ubiquitous nature of NORM, in dealing with situations where natural radiation is significant the cost of any intervention must be taken into account.

A major principle in radiation dose control is that if doses can be reduced by reasonable actions, those actions should be taken. As even low doses of radiation exposure may produce harmful effects, reducing low doses of radiation may be beneficial. The goal is that doses should be As Low As Reasonably Achievable, economic and social factors being taken into consideration. This principle is usually referred to by the acronym ALARA.

Guideline Basis

The Guidelines are based on the most recent international consensus standards recommended by the International Commission on Radiological Protection (ICRP) and CNSC regulations. The recommendations of the ICRP represent a consensus on international radiation protection standards and provide the basis for regulatory control of radioactive materials in virtually all countries of the world. As these regulations and standards are subject to periodic amendments, the Guidelines may also be updated to reflect amendments to accepted national and international radiation protection practices. The ICRP radiation philosophy and recommendations of significance for NORM in Canada are contained in ICRP reports 60, 65, 68,72 and 77. Other paragraphs which illustrate some of the philosophy used in the Canadian Guidelines are given below.

Non-radioactive Hazards of NORM Materials

The Guidelines provide recommendations based on the radiological properties of NORM. In determining an acceptable material management option, other hazardous properties such as chemical toxicity must be considered. In many cases, the non-radiological hazardous properties of NORM materials are the critical selection criteria for the preferred NORM material management option.

NORM Derived Release Limits

To assist in NORM material management, Derived Release Limits (DRLs) have been determined from the annual radiation dose limits. The DRL's provide an estimate of public dose from measured releases of NORM. A Radiation Assessment or Material Management program may compare measurement results to Derived Release Limits (DRLs).

Unrestricted Classification

(Continued on page 15)

CANADA (continued)
The control of public exposure to radiation from NORM disposal is constrained to less than the public dose limit to allow for exposures from multiple sources. The Guidelines recommend that NORM may be released with no radiological restrictions when the associated dose is no more than 0.3 mSv (30 millirems/year, or about 20 microrems per hour for someone exposed 8 hours a day, 200 days per year.) The radioactive hazard associated with this dose is considered insignificant, and no further control on the material is necessary on radiological protection grounds. It may be necessary to consult and obtain approval from Provincial waste disposal regulatory agencies regarding non-radiological properties.

Derived Release Limits for the amount and concentration of NORM materials that meet this criteria have been calculated, and are presented in Tables 5.1,5.2 and 5.3 as Unconditional Derived Release Limits.

Release with Conditions

NORM quantities in excess of the Unconditional Derived Release Limits may, after a specific site review, be released without further consideration. In such instances, the basic premise is that the material, in its final disposition, will not contribute a dose to an individual that is greater than 0.3 mSv/a. Outside those situations or conditions, the material falls within a more restrictive NORM classification.

If available, the finalized Guidelines will be summarized in the next issue of **The NORM Report.** Particularly, the release limits (exempt levels, etc.) and other radiation/radioactivity limits in the Guidelines will be discussed. In some cases the Canadian values are significantly different from those used in most of the United States.

CONFERENCE OF RADIATION CONTROL PROGRAM DIRECTORS (CRCPD)

The final draft of Part N has been approved by the CRCPD Board of Directors. Part N has been sent to several agencies in the federal government for their concurrence to release Part N. The FDA and the EPA did not concur with the release of Part N as written. The NORM Commission considered all the comments from the public (either submitted in writing or as a result of the two stakeholder meetings). Part N has been peer reviewed.

The CRCPD Board of Directors has charged SR-5 with reviewing comments and suggestions from all interested parties that may provide comments and making the necessary revisions as deemed appropriate. SR-5 is also charged with revising the TENORM Guidance Document , once published, concurrent with any revisions to Part N and completing these revisions by the 2001 CRCPD meeting. Tom Hill (Georgia) is the Chairman of SR-5.

Tommy Cardwell of the Texas Bureau of Radiation Control headed up a committee to prepare an implementation guidance document for Part N.

The **Table of Contents** for the guidance document was reproduced in the SUMMER 99 issue of **The NORM Report.**

Questions and comments can be directed to:

Tommy Cardwell
Texas Department of Health
Bureau of Radiation Control
512-834-6688

The Guidance Document has been distributed as a Committee Report. It will be sent out for peer review. The reviewers should have received their copies for review by the end of January. Their comments will be considered and then the Guidance Document will be published as a CRCPD document. At that point it will be listed as one of their publications and available for wide distribution. Copies of the Guidance Document and PART N will be available from the CRCPD office at:

Conference of Radiation Control Program Directors, Inc.
205 Capital Avenue
Frankfort, Kentucky 40601
www.crcpd.org
Telephone: 502-227-4543
Fax:502-227-7862

When available, the Guidance Document will be summarized in **The NORM Report.**

The CRCPD 2000 Directory of Personnel Available

The ***2000 Directory of Personnel Responsible for Radiological Health Programs*** is now available. The fee again this year is $30 for a hard copy. For more information or to order this and/or any other CRCPD document, contact Bettye Merriman at 502/227-4543.

Criteria for an Adequate Radiation Control Program

This report is now available from the CRCPD. The document responds to a need to update the five previously published criteria documents, to add new program areas for low-level waste and non-reactor emergency response, and to consolidate and integrate the crite-

(Continued on page 16)

CRCPD (continued)

is available for $15 per copy, which includes postage and handling. To obtain a copy, please send your order and payment or purchase order to CRCPD, Attn: Bettye Merriman, 205 Capital Avenue, Frankfort, KY 40601.

μR Standards Workshop White Paper Available

CRCPD, USDOE, CIRMS, and N1ST held this workshop on May 13, 1999, to document the need for μR standards and develop an action plan to establish NIST traceability. CRCPD requirements for μR measurements are given in Part N. The technically enhanced naturally occurring radioactive material (TENORM) rule has been approved by the CRCPD Board of Directors and distributed to the states for use. The public release dose-rate criteria in the TENORM rule is below 0.05 mR/h (50 μR/h). Measurement traceability currently ends at 0.5 mR/h.

μR instruments are used to find areas for further investigation, to release materials into recycling operations, to determine compliance with TENORM release criteria (e.g., pipe scale), and to verify decommissioning activities in the field (i.e., is it clean enough?). For a particular site, a state may be willing to do comparisons between radiochemistry lab results and the survey instrument results under actual field conditions, and then use the survey instruments for most decisions in the field. This results in great savings in time and dollars by allowing decontamination to continue without long delays waiting for radiochemical analysis.

The five-page white paper was published by CIRMS. It can be obtained by contacting Robert Lommler at <lommler@idn.state.il.us> or by fax at 217/786-7223. ■

NORM IN EUROPE - A REGULATION PERSPECTIVE

by

Charles Simmons

Editor's note: This article was prepared by Charles Simmons who is a partner in the Washington, D.C. law offices of Kilpatrick Stockton LLP. His area of specialty is Environmental and Natural Resources. Charles can be contacted at csimmons@kilstock.com. I very much appreciate Charlie preparing the article for **The NORM Report**.

In 1995, European industries were confident that the fractious US regulatory picture for NORM would never be experienced at home. This confidence has eroded, however, beginning with a 1996 European Commission Directive binding the Member States to implement revised radiation protection rules. The compliance date of the Directive -- May 13, 2000 is fast approaching and there remains significant uncertainty as to how Member States will implement those provisions of the Directive dealing with NORM. This article provides an overview of how NORM regulation is expected to evolve in Europe as a result of the Directive. Two events in 1996 set in motion profound changes to the way NORM can be expected to be regulated in European countries. The International Atomic Energy Agency (IAEA) published the ***International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115***[1] ("SS 115") which included provisions for regulatory control involving notification, registration and licensing on the basis of radionuclide concentration and dose. According to SS 115, exposures to ionizing radiation should be subject to regulation unless dose was "in the order of 10 microsieverts (1 millirem) per year." IAEA recommendations are analogous to "model rules" in that such recommendations are not enforceable until adopted by a legislature. In this regard, the IAEA recommendations served as the basis for European Commission (EC) Directive 96/29, ***Basic Safety Standards for the Protection of Workers and the General Public Against the Dangers from Ionising Radiation***, issued in May 1996[2]. A European Commission Directive mandates all Member States of the European Union (EU)[3] to implement national legislation consistent with the terms of the Directive, in the case of Directive 96/29 by May 13, 2000.

Title VII of Directive 96/29 establishes a framework for regulatory control over ***Significant Increase in Exposure due to Natural Radiation Sources***. Title VII expressly applies to "work activities" involving NORM that is not exploited for its radioactive content where "the presence of natural radiation sources leads to a significant increase in the exposure of workers or of members of the public which cannot be disregarded from the radiation protection point of view." As such, Article VII establishes a regulatory framework for worker protection that would apply to occupational NORM exposures considered "significant" by the Member State's regulatory authority. Further, since "exposure" is broadly defined as "the process of being exposed to ionizing radiation," and in a health physics sense is distinct from "dose," work involving exposure alone, unaccompanied by significant dose could conceivably be targeted by national authorities. Unlike US regulatory structures for NORM, the Directive makes no apparent distinctions between NORM and technologically enhanced NORM[4]: exposure to natural sources of ionizing radiation is the object of Title VII, regardless of whether the source is "unenhanced" or "enhanced." Article 40 of the Directive provides some indication of work activities that may be of concern, including:

- Work activities where workers or members of the public may be exposed to thoron (Rn^{220})

[1] IAEA and EU publications may be obtained from Beman Associates, 461 I-F Assembly Drive, Lanham, MD 20706 Tel. (1-800) 274 4447. The genesis of IAEA SS 115 lies in the ICRP 60 recommendations of 1990 (contact: www.icrp.org).

[2] For information on the European Commission, see http://europa.eu.

[3] The fifteen Member States in the European Union are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and the United Kingdom.

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NORM IN EUROPE - A REGULATION PERSPECTIVE (Continued)

or radon (Rn^{222}) daughters or gamma radiation in spas, caves, mines, or underground or aboveground workplaces in identified areas;

- work activities involving "operations with, and storage of, materials, not usually regarded as radioactive but which contain naturally occurring radionuclides, causing a significant increase" in worker or public exposure;

- work activities which lead to the production of residues not usually regarded as radioactive but which contain naturally occurring radionuclides, causing a significant increase in public or worker exposure.

Where a regulatory authority determines that worker doses from a given NORM activity rise to a level of "significance" to warrant regulatory oversight, the authority is guided by the provisions of Article 41. which includes exposure monitoring, reporting, or other intervention, "to the extent that the Member States have declared that exposure to natural radiation sources due to work activities ... needed attention and had to be subject to control."

Thus, under Title VII of Directive 96/29, Member States are required to evaluate work activities involving NORM based on exposure to ionizing radiation and determine whether such exposure rises to a level that would trigger some form of regulatory control. In this regard, the Directive affords a measure of flexibility to the national authority in determining what is "significant" for regulatory purposes. What is a "significant" workplace exposure for NORM? European regulators can be expected to differ on this issue according to the level of conservatism that a national radiation protection policy embraces.

To assist national regulators in decision-making with respect to workplace NORM exposure governed by Title VII, the European Commission published ***Radiation Protection 95: Reference levels for work - places processing materials with enhanced levels of naturally occurring radioactive materials*** (July 1999) (hereafter, "RadPro").[5] The RadPro 95 document is intended to guide national authorities in identifying industries of concern for worker protection by establishing dose-based reference levels for regulatory control. For this reason, it fair to assume that the principles set forth in the guidance will form the underpinnings of workplace NORM regulations in the Member States. The basic premise of RadPro 95 involves estimating worker dose from a given work activity/NORM-containing material combination and extrapolating to identify the activity concentration of naturally occurring radionuclides in material processed, and ultimately establish the level of regulatory control to be placed upon the industry.

The regulatory scheme suggested by RadPro 95 involves a tiered system of "control bands" where each band defines a level of regulatory stringency that is intended to correspond to worker risk from ionizing radiation attributable to workplace NORM. The control bands are graded according to Effective Dose to workers under "normal" and "unlikely" exposures, as shown in the table on page 19.

The guidance supports the use of screening levels for NORM to simplify application of the above scheme: three materials screening levels, based on specific activity of the "most significant nuclide (or nuclide

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4 See: Conference of Radiation Control Program Directors (CRCPD), ***Regulation and Licensing of Technologically Enhanced Naturally Occurring Radioactive Material (TENORM)*** for a model regulatory framework governing TENORM by the states. Of course, U.S. jurisdictional distinctions between natural nuclides on the basis of isotopic identity (e.g., "source" materials subject to Atomic Energy Act) are not made in Europe; Article 2 of the Directive does, however, distinguish "cases where natural radionuclides have been processed in view of their radioactive, fissile or fertile properties..."

5 ISBN No. 92-828-6616-5. RadPro 95 is the result of a research contract with the UK National Radiological Protection Board (NRPB) and the French Centre d'Etude sur l'Evaluation de la Protection dans le domains Nucleaire (CEPN), contract 95-ET-009)

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NORM IN EUROPE - A REGULATION PERSPECTIVE (Continued)

Control Band	Level of Control	Effective Dose	
		Normal	Unlikely
1	no regulations	<1 mSv/y	<6 mSv/y
2	lower level regulatiuon	1 mSv/y<dose<6 mSv/y	6mSv/y<dose<20 mSv/y
3	higher level regulation	6mSv/y<dose<20 mSv/y	20 mSv/y<dose<50 mSv/y
4	process not permitted unless dose can be reduced	>20 mSv/y	>50 mSv/y

segment)" establish the boundaries between regulatory control bands. Of course, many assumptions must be made when estimating potential worker dose from a given material; among the assumptions made in translating dose to activity level for screening purposes, the guidance assumes that radionuclide content for a given industrial material is constant and doses are estimated using the activities assumed to be present in the material. Screening levels for common materials are set forth in Appendix 3 of the guidance. Examples of screening levels are: phosphate ore below 0.2Bq/g[6] U-238 -- no regulation; 0.2 to 1.0 Bq/g -- lower level of regulation; 1.0 to 3 Bq/g -- higher level of regulation. The guidance acknowledges that screening levels are estimates, and the accuracy with which doses are estimated is improved where more detailed analytical information on a given material is available. Appendix 4 of the guidance establishes "reference levels" of total specific activities of all significant decay progeny intended to more accurately establish which regulatory control band would apply. Appendix 5 contains a "worked example" for zircon sand.

The Rad:Pro 95 guidance offers a tiered, dose-based scheme for regulating NORM in the workplace. In this regard, it offers a rational approach to NORM regulation and warrants further study by U. S. regulators. Unfortunately, the conclusions made with respect to dose estimates from common NORM-containing materials and industrial operations are based on incomplete or erroneous data, on very conservative modeling assumptions, or both. In the absence of contrary technical information on materials and actual doses -- European regulators could be expected to follow the regulatory design of RadPro 95 in controlling NORM-containing materials in the workplace. It is therefore incumbent upon industries doing business in Europe to accurately characterize their materials, confirm whether worker exposures would be a concern according to the tiered regulatory structure, and to develop a sound technical dossier on their materials in the workplace. This approach increases the likelihood that NORM-containing materials are appropriately regulated and that regulators do not over-regulate on the basis of faulty information or unrealistic assumptions.

Current European NORM Regulations

Under Directive 96/29, Member States have until May 13, 2000 to implement the terms of the Directive. The following is a brief summary of the status of regulations affecting NORM in the U.K., Germany and France:

- **United Kingdom** - the Ionising Radiation

(Continued on page 20)

[6] 1 Bq equals 27 picocuries

NORM IN EUROPE - A REGULATION PERSPECTIVE (Continued)

Regulations of 1999 ("IRR 99"), effective January 200O, and the Approved Code of Practice support a conclusion that worker exposures greater than 1 mSv/y are "significant." Regulation 3.1 of IRR 9.9 extends the scope of IRR 99 to work "with any radioactive substance containing naturally occurring radionuclides." Regulation 5 provides for prior authorization by the Health and Safety Executive ("HSE") of practices involving exposure to ionizing radiation, including "the processing of products." Regulation 6 of IRR 99 requires employers to notify the HSE of work activities involving materials exceeding 1O Bq/g (270 pCi/g) Ra-226 (in equilibrium); 1 Bq/g (27 pCi/g) Th-232 (in equilibrium); or 1 Bq/g (27 pCi/g) U-238 (in equilibrium) (See Schedule 1 for exemption values). Regulation 5(2) appears to allow the HSE to issue generic authorizations for use of certain NORM. The IRR 99 are available at Her Majesty's Stationary Office's web page: **http://www.hmso.gov.uk/si/si1999/19993232.htm.**

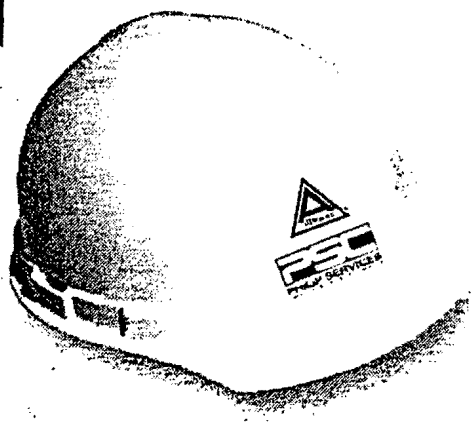
- **Germany** follows the tiered scheme of RadPro 95: doses below 1 mSv/y are exempt; 1-6 mSv/y requires inquiry and establishing good practice; >6 mSv/y requires intervention. The 1997 modifications to the Strahlenschutzverordenung (Radiation Protection Ordinance) included provisions to implement Title VII of the Directive. See: **http://www.bfs.de/home.htm.**

- The situation in **France** is less clear, with nuclear and non-nuclear ionizing radiation falling under several authorities. It was recently reported that "transparency,, safety and radiation protection" bill drafted by Environment Minister Dominique Voynet will be considered by the government and be submitted to the French Parliament in early 2000. The legislation provides for creating an "independent, non-government authority" to regulate nuclear safety and radiological safety. At present, both environment and industry ministers oversee the nuclear safety authority, while only the health ministry oversees the radiological protection authority. See: **http://info-france-usa.org/nuclear.** ■

Warning: A Single Gamma Ray Can Kill You! (Or Can It?)

As opponents to the use of radiation have stated on numerous occasions, radiation is always harmful, regardless of how small the dose. They have even gone so far as to tell the world that a single gamma photon can produce a fatal cancer. It is important to quantify the risks that an average person experiences. According to the NRPB (1989), the average person every hour of his/her life is exposed to the following radiations from naturally occurring sources: 200 million gamma rays from the soil; 400,000 cosmic rays and 100,000 neutrons from outer space; and the emissions from 15 million potassium atoms and 7,000 uranium atoms that decay within our bodies, and from 30,000 naturally occurring radionuclides that decay within our lungs. Neglecting the fact that many radionuclides emit multiple radiations per decay, this means that a total of at least 215,537,000 radiations bombard our bodies every hour. Assuming an average lifespan of 75 years, one can calculate that a total of almost 1.5×10^{14} radiations will have the potential of interacting with our bodies during our lifetime. Data show that, in the United States, about 20 percent of the population currently dies from cancer. If we neglect all other sources of radiation, and if we assume that natural background radiation is the source of all cancer fatalities in the United States today, this means that each one of us has a 20 percent chance that one of these 1.5×10^{14} radiations will produce a fatal cancer in our bodies. Translating this into a probability the chance of dying per photon or emitted particle that bombards our body is about one in 10^{15}, that is, the chance is about one in a million billion. The opponents of radiation are correct — a single gamma can kill! ■

Defining Oilfield Services



oil·field ser·vic·es – see "Allwaste", a Philip Services Company, defining oilfield services for 16 years.
all·waste – synonymous with pride, quality and safety.

- State-of-the-art NORM facility
- Highly trained professionals
- Turnkey capabilities
- Disposal Management
- Regulatory interface
- Direct access to rail spur
- Wet & dry method of pipe decon available
- Trained in DOT shipping requirements
- Pb210 Po210 decon via chelation
- Licensed in LA & TX with reciprocal agreements in other states
- 6 Onsite Radiation Safety Officers
- Direct access to navigable waterway
- Isolated work bays
- Waste minimization and consolidation
- Offer pipe-in-trade options
- Offsite remediation & surveying
- Pipe & equipment decontamination

MORGAN CITY OFFICE
9743 Highway 90 East
Morgan City, Louisiana 70380
Phone: (504) 631-3325
Fax: (504) 631-2817

MORGAN CITY NORM FACILITY
138 Tiger Court
Morgan City, Louisiana 70380
Phone: (504) 631-3973
Fax: (504) 631-0209

GOLDEN MEADOW OFFICE
21148 Highway 1
Golden Meadow, Louisiana 70357
Phone: (504) 475-7770
Fax: (504) 475-5916

VENICE OFFICE
40360 Hwy 23 South
Boothville, Louisiana 70038
Phone: (504) 534-2008
Fax: (504) 534-2876

24-Hour Spill Response — 1-800-797-9992

PSC PHILIP SERVICES CORP.

LAFAYETTE OFFICE
543 Renaud Road
Lafayette, Louisiana 70507
Phone: (318) 233-4889
Fax: (318) 233-4106
(888) WE'RE NOW 1
Website: www.philipinc.com

Radioactive Wastes and the Environmental Protection Agency

There are some caveats regarding radioactive material and the EPA. EPA considers radioactive material hazardous waste covered under CERCLA. Therefore, you retain liability for proper disposal of the material FOREVER. So if your waste broker illegally dumped your waste, you are liable for the clean up costs and will be followed by the EPA's cost recovery lawyers. There are also reporting requirements to the national response center if you have a spill or release. ■

A New NORM-TENORM Listserv

During the past year Phil Egidi has received requests to his TENORM web site asking him to set up a dedicated listserv (mailing list like RADSAFE) for NORM-TENORM issues. Although somewhat reluctant at first, Phil decided that it is time for NORM-TENORM to have its own forum. This is because many of the questions he was receiving are not directly related to health physics/radiation safety, but are more generic (not to be confused with stupid), and may be considered off-topic for RADSAFE.

Please consider joining this new listserv, all input is welcome, expertise and experience will certainly help people who are impacted in this growing field of operational safety, regulation, and environmental restoration.

To join the NORM-TENORM listserv, send an e-mail to the following address:

majordomo@mailhub.ornl.gov

In the body of the message type:

subscribe to norm-tenorm and (your e-mail address)

Editor's note:
Phil Egidi's web site is an excellent resource for NORM and TENORM. If you haven't visited the site it is highly recommended. The URL is:

www.normis.com/nindex.htm ■

EVALUATION OF EXPOSURE TO TECHNOLOGICALLY ENHANCED NATURALLY OCCURRING RADIOACTIVE MATERIALS (TENORM) IN THE PHOSPHATE INDUSTRY

This 250+ page report was sponsored by the Florida Institute of Phosphate Research to characterize NORM in the phosphate industry. Although the report is dated July, 1998, it was not available until late in 1999 as Publication No. 05-046-155. It is available without charge from:

Florida Institute of Phosphate Research
1855 West Main Street
Bartow, FL 33830
Tel: 941-534-7160

The report's Perspective and Executive Summary are reproduced below.

PERSPECTIVE

Several years ago the Florida Institute of Phosphate Research (FIPR) published an Agency Strategic Plan for the years 1998-2003. This described the agency's mission that must be accomplished, and described strategic research and planning efforts to be followed to meet that mission. Six research priorities and four program priorities were adopted by the Institute in order to identify the directions the agency should move toward in accomplishing its mandate. Within the enviromental area, the field of Public Health was identified as one of the six research priorities. A part of the public health objective was to define the magnitude of occupational exposures to hazardous materials within the industry, specifically to "Continue studies to determine if there are significant occupational-related risks to the health or safety of persons employed within the phosphate industry." This study was designed to determine if there were significant exposures to ionizing radiation among industry and support employees, and, if so, to recommend procedures to minimize those exposures.

Over the past twenty or so years, several studies have been made of radiation exposures to employees in the phosphate industry, primarily by personnel from the University of Florida and the Florida Department of Health. Generally those studies found very few employee exposures in excess of 500 millirem (mrem) whole body per year, which at that time was the allowable limit for members of the general public. Many phosphate industry workers are trained in radiation safety, and are monitored, and hence are considered radiation workers. For them an occupational limit of 5,000 mrem per year applies. However, many other workers are not trained in radiation safety, and hence they are considered members of the general public in ten-ns of exposure limits. Moreover, within the past few years the state Department of Health has reduced the annual exposure limit for the public to 100 mrem. This new limit applies to radionuclides whose concentrations have been increased by human activities, and not to background radiation. With the new limit, and with changes in industry practices and materials over the years, it was not clear as to the current status of exposures or of compliance. Hence this study was performed.

The goals of the project were (1) to collect new data as needed and interpret that and existing data on radiological exposure in the Florida phosphate industry and associated service industries, and (2) to make recommendations as necessary to minimize radiological exposures in the industry.

The primary goal of any radiation control program is to maintain exposures at a level of "As low as reasonably achievable," the ALARA concept. Results of this study indicate that average exposures in the phosphate industry are to levels that are much less than the 100 mrem/year limit, and very few employees are exposed in excess of the limit. Only in shipping and handling of dry product were average exposures found in excess of 100 mrem/year. Recommendations are made in the report for lowering these exposures. In no case were average exposures to radiation workers found to exceed 5,000 mrem/year.

EXECUTIVE SUMMARY

The overall objective of this investigation was to provide information to the state of Florida regarding the radiation exposures to workers in the phosphate industry due to technologically enhanced naturally occurring radioactive materials (TENORM) and to provide recommended methods for reducing those exposures. This objective was met by collecting existing radiological data specific to central Florida and the phosphate industry, and generating new data from sampling activities. This study also uses a new computer analysis technique that calculates doses as distributions

(Continued on page 18)

EVALUATION OF EXPOSURE TO TENORM IN THE PHOSPHATE INDUSTRY (continued)

rather than point estimates. This provides a measure of uncertainty as described by statistical descriptors. Lack of uncertainty accounting has been a shortcoming of past studies.

The sampling effort involved phosphate mines, chemical plants, and outside contractors. External exposures were monitored using scintillation (micro-R) meters, ion chambers, lithium fluoride thermoluminescent dosimeters, and aluminum oxide dosimeters in conjunction with time and motion studies. Internal routes of exposure (mainly inhalation) were studied using air sampling, gross alpha and beta counting, and deposition sample analysis. The mean annual total effective dose equivalent (TEDE) to a phosphate industry worker was computed using Latin Hypercube sampling (a random sampling method) on measured parameters for each of six generalized areas.

The sampled areas were: mine area, rock handling area, phosphoric acid production area, dry products (granular) production area, shipping area, and service area. Mine area workers were monitored in all phases of site operations including: pit gun operation within the pit cars, washing area, and flotation area. The next area monitored was the rock handling area at the chemical plant site which included: rock receiving by rail or truck, wet grinding, sizing, storage, and cleaning of spillage by bobcat and shovel. The phosphoric acid production area involved the attack tank (reactor) area, all aspects of filtration (routine operation, cloth patching, cloth change-out), gypsum stack maintenance, and clarification. The dry products area included all aspects of monoammonium phosphate (MAP), diammonium phosphate (DAP), granular triple superphosphate (GTSP), and animal feeds production, drying, and sizing. The shipping area involved movement of dry products from production to storage, and out to-market by payloader operators and laborers. The service sector included: pan maintenance, valve work, pump work, and rubber-lined pipe and vessel maintenance. Special turnaround activities monitored were attack tank cleaning (agitator removal and hydroblasting), removal of associated flash coolers and condensers, filter pan disassembly and reassembly, and filter pan chipping and cleaning.

The TEDE equation used in the generation of dose distributions and sensitivity analyses contained 30 parameters (variables) that were each described as statistical distributions. For example, a typical statistical distribution for a parameter may have been log normal or normal, and the computer selected a value from that distribution (and the numerous other parameters) to generate a calculated dose. The dose for each area was the result of 10,000 separate calculations of the dose by computer selection of random values from each of the distributions. The final result for each area was a dose distribution, displayed numerically and graphically, in units of mrem per year. The final calculated TEDEs for each area based on measured parameters are displayed below. The mean annual total effective dose equivalent (TEDE) to a phosphate industry worker was computed using Latin Hypercube sampling on measured parameters for each of five generalized areas. The areas and results (TEDE average, 99th percentile) in mrem, and rounded to the nearest whole number, are: mining area (12, 20), rock handling area (30, 60), phosphoric acid production area (34, 45), dry products (granular) area (38, 55), shipping area (112, 350), and contracted service worker (8, 11).

Other special turnaround activities based on monitored activities typical for the industry and frequency of such jobs, as reported by the service supervisors, yield doses are as follows: The **tasks** and results (TEDE average, 99th percentile) in mrem, and rounded to the nearest whole number, are: filter assembly (22, 80), pan chipping/cleaning (22, 60), and attack tank cleaning (73, 250).

Use of this uncertainty analysis technique also gives insight into effects of each parameter on the variability of the final dose. That is, of particular interest is to find which parameters tend to increase the spread of the distribution to higher dose levels. Different parameters were more important in different areas. The

(Continued on page 19)

EVALUATION OF EXPOSURE TO TENORM IN THE PHOSPHATE INDUSTRY (continued)

value of this analysis is that it becomes clear that workers in areas of airborne dust or mist should wear a basic NIOSH/MSHA-approved respirator (with a proper fit). In general, the best allocation of resources (time and money) to reduce radiation doses is for training in the proper use of respirators and encouraging their use. This is particularly important in the shipping and dry products areas, for filter cloth change-outs, dry pan chipping of gypsum scale, and attack tank hydroblasting.

Excessive radon levels were limited to the rock tunnels; however working level measurements in the tunnels were consistently low (<0.95 mWL) indicating that the air is replaced frequently enough to prevent large equilibrium fractions of radon daughters. Also, rock tunnels are low occupancy areas, visited rarely by laborers responsible for shoveling spills, and maintenance workers responsible for repairing conveyors. It is sufficient to recommend that rock tunnels be ventilated prior to entry so that all of the air is replaced, and that the ventilation remain 'on' during the period of work.

In conclusion, most workers employed by the phosphate companies receive training commensurate with the level of radiation hazard they encounter. Those workers are subject to the occupational exposure limit of 5,000 mrem/yr TEDE. The finding of this study is that it is extremely unlikely that this limit would be approached or exceeded. Engineering controls and the use of respirators should be considered part of the ALARA commitment.

Service industry workers are often not trained in radiation safety, and are consequently subject to public dose limits. This study found that service industry workers working on phosphate company sites, and more often at remote service company locations, receive doses far below the 100 mrem/yr TEDE limit for a member of the public. The only exception to this finding is workers involved in attack tank cleaning. The most significant component of the TEDE for those individuals is the inhalation dose. It is recommended that a more targeted study be conducted to reduce uncertainties in that dose component, so that appropriate actions may be taken. ■

TENORM Legislation - Theory and Practice

by Nick Tsurikov

(**Editor's note**: This was previously printed in the Summer 99 newsletter where the email address of Nick Tsurikov contained an error. My sincere apologies to Nick.)

Activities and work practices in which radiation exposure of workers and members of the public is increased due to the presence of Naturally Occurring Radioactive Material (NORM) are receiving increased attention from regulatory agencies and, to a lesser extent, from the general public. Proposed national and international radiation protection standards are likely to bring many industries into the realm of regulatory concern. Attention focused on industries where enhancement of natural radioactivity takes place and radiation exposure of workers and members of the public may be comparable to that for already 'controlled' activities. However, industries, where technological enhancement of NORM results in only small increases of radiation exposure, could also become 'regulated' in accordance with the provisions of the'new' radiation protection legislation. One of such industries is mining and minerals processing in general. Verbatim adoption of Basic Safety Standards (BSS) of the International Atomic Energy Agency into a national legislation without a full assessment of health, economic and legal consequences could present enormous practical problems. Therefore, it is appropriate to discuss if these Standards prescribe appropriate control measures for the Technological Enhancement of Natural Radioactivity, especially in mining and minerals processing.

The full text of ***TENORM Legislation - Theory and Practice*** is available from **nick.tsurikov@iluka.com**. The paper was presented at TENORM-11, Rio de Janeiro, 12 - 17 September 1999. The full text is also available at Tsurikov's "World Radiation Links" Internet site: **http://eneabba.net**. ■

NORM Technologies Website Under Development

Argonne National Laboratory currently is developing a **NORM Technologies Website** to assist operators in their efforts to resolve NORM-related waste management issues. The **NORM Technologies Website** will provide easy access to current information about companies providing all types of NORM services, including site characterization and remediation support, sample collection and analysis, radiation safety program development, radiation safety training, transportation, and NORM waste treatment and disposal.

Company-specific information that will be available on the website will include current contact information plus a description of the company's experience and, if available, a link to the company's own website. Company participation in the website will be free, meaning that any company wishing to post information about itself will be able to do so at no charge. Similarly, public access to the website also will be free.

The **NORM Technologies Website** also will provide access to current information about state agencies that have jurisdiction over NORM wastes, including links to state websites providing access to the applicable regulations. In addition, the **NORM Technologies Website** will host a Discussion Forum within which individuals can pose specific questions related to NORM management.

The **NORM Technologies Website** is anticipated to be publicly accessible sometime in mid-2000. Development of the website is being funded by the U.S. Department of Energy's National Petroleum Technology Office. The **NORM Technologies Website** will be hosted by the Interstate Oil and Gas Compact Commission. Individuals seeking additional information about this website may contact Karen P. Smith at Argonne National Laboratory. Ms. Smith's phone number is (303) 986-1140, ext. 267 and her email address is smithk@anl.gov.

NORM Manuals Available

The manual which I use in teaching my 2-day course ***NORM Contamination - An Emerging Environmental Problem*** is available. The manual contains over 650 copies of the slides used in the course. Although designed originally for the oil and gas industry, the manual also contains material about NORM contamination in other industries.

In addition to being an inclusive text on NORM, the manual can be easily used to structure in-house information or training courses on NORM.

The Table of Contents shown below indicates the range of topics in the manual.

1. Fundamentals of Radiation Protection
2. Radiation / Radioactivity Units
3. Biological Effects of Radiation
4. Radiological Protection
5. Introduction to NORM Contamination
6. NORM Contamination - Radium
7. NORM Contamination - Radon
8. NORM in Oil & Gas & Other Industries
9. Fundamentals of Radiation Detection
10. NORM Surveys
11. Disposal of NORM Wastes
12. Regulations - General
13. Federal Regulations
14. State Regulations
15. Regulations - Conclusions
16. Recommended Industrial Hygiene
17. Program Suggestions for NORM Control
18. Radiation Litigation & Minimization
19. Conclusions
20. Glossary

For further information contact:
Peter Gray
P.O. Box 11451
Fort Smith, AR 72917
TEL (501)646-5142
FAX (501)646-5359
E-mail: pgray@normreport.com

In addition to the manual for the 2-day NORM course the manual from my 1-day course is also available. The two manuals are similar in content—but the 2-day course manual is more detailed. The 1-day course manual contains about 400 slides.

The cost of the 2-day course manual is $195 (US) and the cost of the 1-day course manual is $125. ■

EPA Proposed Rule for Storage, Treatment, Transportation, and Disposal of Mixed Waste

The Environmental Protechion Agency (EPA) seeks to amend its regulations under subtitle C of the Resource Conservation and Recovery Act (RCRA) to provide a conditional exemption from certain requirements for eligible mixed waste. EPA is requesting public comments on this proposed action.

Background

Mixed waste is a radioactive RCRA hazardous waste. It is regulated under two authorities: 1) the Resource Conservation and Recovery Act (RCRA), as implemented by EPA or authorized states for the hazardous waste component; and 2) the Atomic Energy Act of 1954, as amended (AEA), for the radiological component as implemented by either the Department of Energy (DOE), or the Nuclear Regulatory Commission (NRC) or its Agreement States.

Summary

The focus of this proposal is to provide flexibility under RCRA Subtitle C to generators of eligible mixed waste. We are proposing a conditional exemption from the definition of hazardous waste applicable to: low-level mixed waste (LLMW) for storage; and LLMW or Naturally Occurring and/or Accelerator-produced Radioactive Material (NARM) for transportation and disposal. The proposal is expected to reduce dual regulation for generators in the management and disposal of their wastes. This flexibility will enable generators of LLMW who are licensed by the Nuclear Regulatory Commission (NRC) to claim an exemption for storing and treating these wastes in tanks or containers (using solidification, neutralization, or other stabilization processes) without a RCRA permit. This proposal will also provide flexibility for the manifesting, transportation and disposal of eligible mixed waste. Waste meeting the proposed conditions will be exempted from certain RCRA Subtitle C hazardous waste requirements and managed as radioactive waste in accordance with NRC regulations.

For More Information

The Federal Register Notice and this fact sheet are available in electronic format on the Internet at <http://www.epa.gov/radiation/mixed-waste>. To order copies of this document, call the RCRA Hotline, weekdays, 9:00 a.m. to 6:00 p.m.. Callers within the Washington Metropolitan Area must dial 703-412-9810 or TDD 703-412-3323 (hearing impaired). Long-distance callers may call 1-800-424-9346 or TDD. Write to the RCRA Informtion Center (5305W), US EPA, 401 M Street SW, Washington, DC 20460. Address e-mail to rcra-docket@epamail.epa.gov. ■

Regarding Landfill Portal Radiation Monitors

I suspect that the primary motivation behind landfill owners/operators installing sensitive portal radiation monitors is NOT a state regulatory requirement (indeed, aside from prohibitions on disposal of rad waste, I am not aware of any federal or state regulations that establish a portal monitor requirement, set-point, calibration, operator training, etc.) -- rather, operators of typical non-hazardous RCRA "D" landfills permitted to receive non-hazardous waste do not want to incur any cleanup liability for rad contamination under CERCLA ("Superfund") or comparable state law. Portal monitors are prevalent and their use is expanding, without comparable education, training, or standardization. The usual practice seems to be a "background zero" which results in many hits.

This phenomenon is presenting increasing difficulties for persons who dispose of refractory materials, among other non-RCRA industrial solid wastes that are slightly elevated in natural uranium and thorium. My understanding is that some states provide informal guidance; and CRCPD has drafted a guidance document, but more education is needed since portal monitors are evolving into a "practice."

Charles Simmons
Counsel for the Zirconium Environmental Committee
csimmons@kilstock.com
202/508-5806 ■

Radioactive Waste Broker & Processor Services,[1] CRCPD Notes of September 1999

Firm / Principal Region	Contact Person	Telephone / Fax.	e-mail	Will Assist with: Neutron Sources	Other Sources	Mixed Waste	Import/ Export	Will Provide: Rad.Mat. Identif.[2]	Recycle Brokering	Storage for decay	Incinerate & Return	Compact & Return	Stabilize[3] & Encapsulate
ADCO Services All states	Lon Wahlberg	708/429-1660 -9759	jbel@adcoservices.com	Yes	Yes	Yes	Yes	No	Yes	<6 Mo.	Broker	Broker	U & Th
AEA Technology All states	Richard Yelland	412/655-6143 -8170	yelland@aeatech.com	Yes	Yes	sealed	Yes	Yes	Yes	no	no	no	no
Applied Health Phy. Northeast	Todd Mobley	412/835-9555 -9559	ahp@icubed.com	Yes	Yes	Yes	Yes	Yes	Yes	<6 Mo.	Broker	Broker	Broker
Bionomics East & Mid-West	John McCormick	800/578-6513 423/376-4291	j_mccormick_bionomics@msn.com	Yes	Yes	Yes	Some	Yes	Yes	Broker	Broker	Broker	U & Th, Ac NO_3 etc.
Chem Nuc. Systems All states	Angus Hinson	803/259-1781 541-7302	ahinson@wm.com	Yes	Yes	Yes	Yes	Yes	Yes	No	Broker	Yes	Resins, liquids
GTS Duratek All states	Daniel Ladd	423/220-1617 -1643	dladd@bcp.gtsduratek.com	Yes	Yes	LSC	Yes	Yes	Yes	Broker	Yes	Yes	Diverse materials
NDL Organization N eastern US	Peter Pastorelle	800/635-6351 737-9244	info@ndlorg.com	Yes	Yes	Some	Some	Yes	Yes	Yes	Broker	Broker	Broker
NFS Eastern	David Wise	423/743-1795 -2514	rdwnls@aol.com	Some	Some	Yes	Yes	Yes	Yes	No	No	Yes	Hg, Pu, U, TRU
NSSI Southern	Robt. Gallagher	713/641-0391 -6153	rdgallagher@nssihouston.com	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Broker	Broker	Chemicals Mxd Wst
Perma-Fix Environ. All states	Ben Warren	352/395-1352 372-8963	bwarren@perma-fix.com	No	Yes	Yes	Yes	Yes	Yes	<3 Yr.	Broker	No	Mxd Wst. et al.
Philotechnics All states	Andy Armbrust, Don Hartche	423/483-1551 -1530	ajarmbrust@philotechnics.com	Yes	Yes	Yes	Yes	Yes	Yes	Broker	Broker	Broker	Some
Radiac Research NYC	Art Green	718/963-2233 388-5107	agreen@radiacenv.com	Some	Some	LSC	Some	Yes	Yes	Yes	Some	Broker	Broker
Radiation Safety Assoc. Atlantic	K. Paul Steinmeyer	860/228-0467 -4402	rsa@radpro.com	No	Yes	Some	Yes	Yes	Yes	No	Broker	Yes	MgTh NiTh
R.M. Wester Midwestern	Robert Wester	314/928-9628 -9857	MrRMW1@aol.com	Yes	Yes	Yes	Yes	Yes	Yes	<6 Mo.	Broker	Broker	Broker
RSO, Inc. Eastern	David Wellner ext. 306	301/953-2462 497-8383	dwellner@rsoinc.com	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Broker	Broker	Organics et al
Thomas Grey Assoc. All states	Richard Gallego	714/997-8090 -3581	tga@95net.com	Yes	Yes	Yes	No	No	Yes	Yes	Broker	Yes	Liquids
U.S. Ecology East & Mid-West	John O'Neil	423/482-5532 -4776	joneil@americanecology.com	Some	Yes	Broker	No	Yes	No	<6 Mo.	Broker	Yes	Some
Waste Ctrl. Specialists All states	Bill Dornsife	717/540-5220 -5102	wcs@phoenix.net	Yes	Yes	Yes	Yes	No	Yes	Yes & Ra any Amt.	Broker	No	RCRA & TSCA listed

1 All firms deal with leaking sources, contamination, diffuse NORM, burial permits, packaging, and transport. For info on NORM see "The NORM Report" from Peter Gray, 918/492-5250.

2 Identification of radionuclides and amounts in unmarked packages or in contamination.

3 For processing services, only principle waste types are identified. Other processing firms are ATG for resins, sludges, oil & other organics, mixed waste, Rena Echols, 423/482-3275; Diversified Technologies for filters, resins, sludges & liquids, Jim Mooney, 423/539-9000 ext 30, fax -9001; Envirocare, Gene Gleason, 801/532-1330, fax 537-7345, for resins, soils, rubble and other solids including mixed waste; for 11e.2 material International Uranium Michelle Rehmann,... ; for metals and equipment, Alaron 724/535-5777, Mlg. Sciences 423/481-0455, Starmet NMI 800/227-1401, GTS Duratek 423/220-1607, Chem-Nuclear, NSSI and U.S. Ecology (above).

Some firms that transport Rad. Mat. are: Hittman Transport 800/233-9933; Tri-States Motor Transit-Trism Environ. 800/234-8768; Kindrick Transport 423/882-0457; Roadway 800/257-2837 opt 4 TAG Transport 423/354-6927; Chem-Nuclear and RSO Inc. (see entries above).

Please provide corrections to Terry Devine, Ph. 502/227-4543, fax 502/223-7026. *This information is not to be construed as an endorsement by CRCPD, Inc., of the services identified in this list*

Excerpts from theFederalRegister

● 64 FR 54543, 7 October 1999, Final Rule, Effective 4 February 2000: The Nuclear Regulatory Commission (NRC) amended its regulations regarding the use of respiratory protection and other controls to,restrict the intake of radioactive material. The amendments make these regulations more consistent with the philosophy of controlling the sum of internal and external exposure, reflect current American National Standards Institute guidance, are consistent with the recent Occupational Safety and Health Administration respiratory protection rule, and make NRC requirements for radiological protection less prescriptive. The amendments ensure recent technological advances in respiratory protection and procedures are reflected in NRC regulations and clearly approved for use by licensees.

● 64 FR 57785, 27 October 1999, Proposed Rule, Comment by 10 January 2000: The NRC published a notice of receipt of a petition for rulemaking dated 13 August 1999, filed by the Union of Concerned Scientists. The petition, filed 18 August 1999, was assigned Docket No. PRM-30-62. The petitioner requests the NRC amend its regulations concerning deliberate misconduct to require licensees to provide specific training to management, i.e., first line supervisors, managers, directors, and officers, on their obligations under the employee protection regulations. The petitioner believes the amendment would prevent nuclear energy management from using "ignorance of the law" as an excuse for a violation and allow the NRC to take enforcement actions against individuals who violate the employee protection regulations.

● 64 FR 63464, 19 November 1999, Proposed rule, comment by 17 February, 2000: The Environmental Protection Agency (EPA) proposed to provide increased flexibility to facilities that manage low-level mixed waste (LLMW) and naturally occurring and/or accelerator-produced radioactive material (NARM) mixed - with hazardous waste. The proposal aims to reduce the dual regulation of LLMW, which is subject to the Resource Conservation and Recovery Act (RCRA) and Atomic Energy Act (AEA). The EPA proposes allowing on-site storage and treatment of these wastes at the generatorL's site. The proposal requires the use of tanks/containers to solidify, neutralize, or otherwise stabilize the waste. It applies only to generators of LLMW who are licensed by the Nuclear Regulatory Commission (NRC) or an Agreement State. EPA also seeks to exempt LLMW from RCRA manifest, transportation, and disposal requirements when certain conditions 4 FR 63464, 19 November 1999, Proposed rule, are met. Under the conditional exemption, generators and treaters must still comply with manifest, transport, and disposal requirements under the NRC (or NRC Agreement State) regulations for LLW or NARM. ■

The NORM REPORT
A NORM Contamination Newsletter

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Published Quarterly
Editor: Peter Gray, Ph.D.

Federal Guidance Report No. 13.

In September 1999, EPA released the final version of ***Federal Guidance Report No. 13, Cancer Risk Coefficients for Environmental Exposure to Radionuclides (FGR 13).*** FGR 13 contains cancer risk coefficients for over 800 radionuclides. There is also new information on sources of uncertainty in these risk coefficients and an expanded discussion of the dose-response relationship. Copies may be obtained from the EPA National Service Center for Environmental Publications by phone (800-490-9198) or by the Internet (www.epa.gov/ ncepihom). You may also download an electronic copy of FGR 13 from the Radiation Protection Division's Web site at < www.epa.gov/radiation/federal >. ■

Meetings Calendar

2000 American Radiation Safety Conference & Exposition

(The 45th Annual Meeting of the Health Physics Society)

June 25-29, 2000

Denver, Colorado USA

5th International Conference on High Levels of Natural Radiation and Radon Areas: Radiation Dose and Health Effects

This International Conference will be held in Munich, Germany in September 2000. The contact address is A.Bayer, Bfs - Institute for Radiation Hygiene, P.O. Box 1108, D-85758, Oberschleissheim, Germany, Phone:+49-89-31603-230, fax: +49-89-31603-270, e-mail: abayer@bfs.de.

THE FIFTH INTERNATIONAL CONFERENCE ON HEALTH, SAFETY & ENVIRONMENT IN OIL AND GAS EXPLORATION AND PRODUCTION

26-28 June 2000

Stavanger, Norway

The SPE Programme Committee, and the endorsing organizations, invite you and your colleagues to the **Fifth International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production** to be held 26-28 June in Stavanger, Norway. The chosen theme for the conference is **"Progress through Sharing Values".**

This reflects the goal of the conference, which is to promote world wide progress in health, safety and environmental management with all the stakeholders in an open forum. Sharing the variety of stakeholder values with the aim of full understanding and, wherever possible, of agreement, is the key to maintaining the license to operate. Sharing values is also essential in order to be able to continue to improve HSE performance under the very challenging internal and external conditions that the oil and gas industry experiences. For further information please visit the SPE website at **http://www.spe.org/events.**

CANADIAN RADIATION PROTECTION ASSOCIATION ANNUAL MEETING

Montreal, Quebec, Canada

May 29-31, 2000

The theme is 1980-ALARA-2020, that is, what was ALARA twenty years ago. what is ALARA and what will happen with ALARA 20 years from now. Any paper regarding radiation safety or related topics will be considered. People who may want to present posters instead of an oral presentation can do so. Information about deadlines can be found on the Web site. For information:

CRPA Secretariat, C/O Hannah Goedhard
P.O. Box 149. Kemptville. Ontario. KOG 1JO
Fax: 613.258.1336
Tel: 613.258.9020
Email: goedhard@sympatico.ca.
Web site: http://www.safety.ubc.ca/crpa/index.htm

Radiation Protection for Our National Priorities Medicine, the Environment, and the Legacy

17-21 September 2000

Spokane, Washington

This conference will include a suite of classes and workshops which will be submitted to AABP/AABP for approval for CE credits. Planned workshop topics include MCNP, RESRAD, Skyshine calculations, Point Kernel Methods, Radiation Quantities and Units, Medical Isotope Production, and more.

For more information, see our Web site at:
http://www.ambinet.com/ans/rps2OOO.html

NORM in the Literature

An Assessment of the Disposal of Petroleum Industry NORM in Nonhazardous Landfills

by

K. P. Smith, D. L. Blunt, G. P. Williams, J. J. Arnish, M. Pfingston, J. Herbert, and R. A. Haffenden

Argonne National Laboratory
Environmental Assessment Division
Lakewood, Colorado
October, 1999 (77 pages)

In the past few years, many states have established specific regulations for the management of petroleum industry wastes containing naturally occurring radioactive material (NORM) above specified thresholds. These regulations have limited the number of available disposal options for NORM-containing wastes, thereby increasing the related waste management costs. In view of the increasing economic burden associated with NORM, the industry and its regulators are interested in identifying cost-effective disposal alternatives that still provide adequate protection of human health and the environment. One such alternative being considered is the disposal of NORM-containing wastes in landfills permitted to accept only nonhazardous wastes. (Contact Karen Smith at 303-986-1140 x267 for copies.)

The Application of Adaptive Sampling and Analysis Program (ASAP) Techniques to NORM Sites

by

R. Johnson, K. P. Smith, and J. Quinn

Argonne National Laboratory
Environmental Assessment Division
Argonne, Illinois
October, 1999 (106 pages)

Adaptive Sampling and Analysis Program (ASAP) data collection relies on real-time data collection technologies and in-field decision support to guide the course of characterization and/or remediation work. ASAP techniques have particular application to naturally occurring radioactive materials (NORM) problems because of the relative abundance of real-time technologies appropriate for radium-226 (Ra-226). Demonstration work at a Michigan site made use of three real-time data collection technologies operating in an Adaptive Sampling and Analysis framework. These included a gamma radiation detecting walkover/Global Positioning System (GPS) for complete surficial site coverage; *in situ* High Purity Germanium (HPGe) gamma spectroscopy for quantitative isotope specific direct measurements; and a sodium iodide (NaI)-based direct measurement device called RadInSoil™, specifically intended for NORM work. (Contact Karen Smith at 303-986-1140 x267 for copies.)

EFFECT OF LEACHABILITY ON ENVIRONMENTAL RISK ASSESSMENT FOR NATURALLY OCCURRING RADIOACTIVE MATERIALS IN PETROLEUM OIL FIELDS

by

Gerald Rajaretnam and Henry B. Spitz

Health Phys. 78(2):191-198: 20000

Abstract -- Elevated concentrations of naturally occurring radioactive material (NORM), including U^{238}, Th^{232} and their progeny found in underground geologic deposits, are often encountered during crude oil recovery. Radium, the predominant radionuclide brought to the surface with the crude oil and produced water, co-precipitates with barium in the form of complex compounds of sulfates, carbonates, and silicates found in sludge and scale. These NORM deposits are highly stable and very insoluble under ambient conditions at the earth's surface. However, the co-precipitated radium matrix is not thermodynamically stable at reducing conditions which may enable a fraction of the radium to eventually be released to the environment. Although the fate of radium in uranium mill tailings has been studied extensively, the leachability of radium from crude oil NORM deposits exposed to acid-rain and other aging processes is generally unknown. The leachability of radium from NORM contaminated soil collected at a contaminated oil field in eastern Kentucky was determined using extraction fluids having wide range of pH reflecting different extreme environmental conditions. The average Ra^{226} concentration in the samples of soil subjected to leachability testing was 32.56 Bq per gram +/- 0.34 Bq per gram (879 +/- 9 picocuries per gram). The average leaching

(Continued on page 32)

NORM in the Literature (continued)

potential of Ra^{226} observed in these NORM contaminated soil samples was 1.3% +/- 0..46% and was independent of the extraction fluid. Risk assessment calculations using the family farm scenario showed that the annual dose to a person living and working on this NORM contaminated soil is mainly due to external gamma exposure and radon inhalation. However, waterborne pathways make a non-negligible contribution to the dose for the actual resident families living on farmland with the type of residual NORM contamination due to crude oil recovery operations.

MEASUREMENT OF ^{222}Rn FLUX, ^{222}Rn EMANATION, AND $^{226,228}Ra$ CONCENTRATION FROM INJECTION WELL PIPE SCALE

by

Arthur S. Rood, Gregory J. White, and D. Thomas Kendrick

Health Phys. 75(2):187-192: 1998

Abstract—^{222}Rn flux (Bq s^{-1}) was measured from the ends of twenty sections of produced water injection tubing (pipe) containing barite scale contaminated with naturally occurring radioactive material. Exposure measurements near the pipes were as high as 77.4 nC $kg^{-1}h^{-1}$ (300 μR h^{-1}). Flux measurements were accomplished by first purging the pipes with dry nitrogen and then collecting the outflow (nitrogen and radon) on charcoal columns affixed to the end of the pipe for 66 hours. As determined in this manner, ^{222}Rn flux from the ends of the pipe ranged from 0.017 to 0.10 Bq s^{-1} (0.46 to 2.7 pCi S^{-1}). Following the radon flux measurements, pipe scale was removed and a representative sample was taken for ^{226}Ra and ^{228}Ra concentration measurements and determination of ^{222}Rn emanation fractions (the fraction of the total radon contained in a material that is released from the material and free to migrate). The samples were also analyzed for gross mineral content. Emanation fraction measurements for ^{222}Rn ranged from 0.020 to 0.063, while ^{226}Ra concentrations ranged from 15.7 to 102 Bq g^{-1} (424 to 2,760 pci g^{-1}). Barite was the predominate mineral in 17 of the 20 scale samples collected. Much of the previous work dealing with radon emanation fraction measurements has involved uranium mill tailings. Compared to mill tailings and natural soils which have emanation fractions that typically range from 0.1 to 0.3, the emanation fractions measured for these NORM scales are substantially lower.

Evaluation of Guidelines for Exposures to TENORM (1999)

This publication from the Commission on Life Sciences and published by the National Academy Press will be available online. Part of the publication, including its Table of Contents, should be available online at the National Academy of Sciences web site.

MODEL FOR ESTIMATING POPULATION IMPACTS AVERTED THROUGH THE REMEDIATION OF CONTAMINATED SOIL

by

A.B. Wolbarst, J. Mauro, R. Anigstein, D. Beres, M. Doehnert, H. B. Hull, and S. Marschke

Health Phys. 75(1):67-76; 1998

Abstract: This is the second in a series of papers that discuss methodologies being developed and employed by the U.S. Environmental Protection Agency in support of its decisions on cleanup levels for radioactivity contaminated sites that are to be remediated and released for public use. It describes a model, CU-POP, designed by the EPA to obtain estimates of the potential collective radiological health impacts over specific periods of time (100, 1,000 and 10,000 years following cleanup), both on and off site, due to residual radioactive materials in on-site soil. Collective doses and risks are linear in population density, for the direct exposure, dust and indoor radon inhalation, and soil ingestion pathways, it is assumed that specific fractions of all food grown and all groundwater pumped at a site are consumed by on- and off-site populations. The model was developed for application to a set of hypothetical "reference" sites, its testing on a simple generic site is discussed briefly here.

(Continued on page 33)

NORM in the Literature (continued)

Surface and Volume Radioactivity Standards for Clearance (ANSI/HPS N13.12-1999)

For over three decades, a Writing Group of the Health Physics Society (HPS), organized under the American National Standards Institute (ANSI) accredited N13 Committee, has been working on a consensus standard for clearance, or unrestricted release, of materials or items from radiologically controlled areas. Initial attempts to develop the standard began in 1964 and were limited in scope to surface contamination. In 1990, HPS N13 authorized the resumption of efforts to develop the standard because of the continuing need for comprehensive clearance criteria. It was recognized that both surface and volume clearance criteria would need to be considered. For the past nine years, the revised Writing Group has been diligently considering the numerous technical and policy issues associated with clearance and drafting the revised standard. The resulting final standard, was included with the January 2000 issue of the Health Physics Newsletter.

The purpose of N 13.12 is to provide guidance for protecting the public and the environment from radiation exposure by specifying a primary radiation dose criterion and derived screening levels. ANSI N13.12 provides a primary dose criterion of 10 $\mu Sv\ y^{-1}$ or (1 $mrem\ y^{-1}$) and derived surface and volume screening levels. The primary dose criterion is consistent with the recommendations of the International Atomic Energy Agency and was selected for consistency with international commerce. The screening levels are derived from an analysis of several radiation exposure scenarios that were intended to be protective for most situations. However, the standard recognized that site- or case-specific values might be derived for special situations, using 10 $\mu Sv\ y^{-1}$. Unlike previous guidance for surface contamination, the standard provides a single limit for surface contamination, instead of limits for fixed and removable contamination, since the scenario analysis assumed all of the material to be in a removable form. The HPS N13 Committee will develop a second standard to clarify implementation issues such as instrument selection, statistical sampling, and records.

Guide for Control and Release of Technologically Enhanced Naturally Occurring Radioactive Material (TENORM)(ANSI/HPS N13.53-2000)

The third draft of the ANSI/HPS N13.53 TENORM Standard will be submitted for ANSI N13 Committee review and balloting.

The purpose of this standard is to provide general guidance and numerical criteria for the control and release of technologically-enhanced naturally occurring radioactive material (TENORM). The radioactivity in TENORM is due to a few predominant radionuclides associated with two radioactive decay series, namely uranium-238 and thorium-232 and their respective decay products. The standard applies to industries or activities that are not covered by existing Federal or State regulations. In addition, the standard may be adopted by American industries and organizations as guidance in foreign countries in which there are no applicable TENORM regulations or guidelines. The activities considered by this standard include mining and beneficiation of ores; processing of ore material, gangue, and wastes; feedstock used in the manufacture of consumer and industrial products; and distribution of such products. However, the standard does not apply to connnon activities such as tilling or plowing for agricultural purposes and preparation and grading of sites for construction. This standard is concerned with practices and operations that might concentrate radioactivity such that members of the public potentially may receive doses that would warrant the application of appropriate protective measures and corrective actions. Other recommendations suggest that preventive measures, such as engineered safety systems or operational procedures, be implemented to safely manage TENORM in achieving the same objectives. Finally, the control of occupational exposures associated with TENORM is not covered by the standard, as this aspect falls under the requirements of current radiation protection and industrial hygiene standards. ■

Regulatory References

Title 10 CFR Part 20 ----	Standards for Protection Against Radiation
Title 10 CFR Part 61 ----	National Emission Standards for Radionuclide
Title 29 CFR Part 1910.96 ----	Ionizing Radiation
Title 33 U.S.C. 466, et seq. ----	Federal Water Pollution Control Act as amended
Title 40 CFR Part 141 ----	National Primary Drinking Control Program; Criteria and Standards
Title 40 CFR Part 190 ----	Environmental Radiation Protection Standards for Protection Power Operations
Title 40 CFR Part 192 ----	Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings
Title 40 CFR Part 440 ----	Ore Mining and Dressing Point Source Category
Title 42 U.S.C. 300, et seq.----	Safe Drinking Water Act, as amended
Title 42 U.S.C 2011, et seq. ----	Atomic Energy Act of 1954, as amended
Title 42 U.S.C 4321, et seq.----	Toxic Substances Control Act (TSCA)
Title 42 U.S.C. 4341, et seq.----	Conservation and Recovery Act of 1976 (RCRA)
Title 42 U.S.C 7401, et seq. ----	Clean Air Act; as amended
Title 42 U.S.C. 7901, et seq.----	The Uranium Mill Tailings Radiation Control Act of 1978
U.S. AEC 1974 ----	Termination of Operating Licenses for Nuclear Reactors, NUREG 1.86 U.S. Atomic Energy Commission, Washington, D.C. June 1974
ARKANSAS	Rules and Regulations for Control of Sources of Ionizing Radiation. Section 7 NORM
GEORGIA	Rules and Regulations for Radioactive Materials, Chapter 391-3-17, Section 08-Regulation and Licensing of NORM
LOUISIANA Radiation	Title 33: Environmental Quality Part XV: Protection. Chapter 14: Regulation and Licensing of NORM
MISSISSIPPI	Part 801 Section N Licensing of NORM Oil and Gas Board, Rule 69, Control of Oil field NORM
NEW MEXICO	Subject 14: NORM in the Oil and Gas Industry
OREGON	Regulations and Licensing of NORM Oregon Administrative Rules, Chapter 333, Division 117 -- Health Division
SOUTH CAROLINA	Part IX, Licensing of NORM
TEXAS	Texas Department of Health-- Texas Regulations for Control of Radiation (TRCR) Part 46, Licensing of NORM Railroad Commission of Texas-- Rule 94, Disposal of Oil and Gas NORM Wastes

Comparison of NORM Rules by State

Radium Exemption Concentration

AR	5 pCi/g
CO (proposed)	5 pCi/g
GA	5 pCi/g with high radon factor(1) 30 pCi/g with low radon factor(2)
LA	5 pCi/g above background
MI (proposed)	5 pCi/g
MS	5 pCi/g with high radon factor 30 pCi/g with low radon factor
NM	30 pCi/g
ND	5 pCi/g.
NJ	Variable- depending on concentrations and volumes- annual dose less than 15 mrem/yr.
OK (proposed)	30 pCi/g
OR	5/15 pCi/g
SC	5 pCi/g with high radon factor 30 pCi/g with low radon factor
TX	5 pCi/g with high radon factor 30 pCi/g with low radon factor
CRCPD (proposed)	5 pCi/g

Radium Cleanup Standard

AR	5/15 pCi/g(3)
CO (proposed)	5 pCi/g
GA	5/15 pCi/g with high radon factor 30/15 pCi/g(4) with low radon factor
LA	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)	5/15 pCi/g
MS	5/15 pCi/g with high radon factor 30 pCi/g with low radon factor
NM	30/15 pCi/g
ND	5 pCi/g
NJ	Variable- depending on concentrations and volumes- annual dose less than 15 mrem/yr.
OK (proposed)	30/15 pCi/g
OR	5 pCi/g
SC	5/15 pCi/g with high radon factor 30/15 pCi/g with low radon factor.
TX	5/15 pCi/g with high radon factor 30/15 pCi/g with low radon factor
CRCPD (proposed)	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 averaged over the first 15 centimeters of soil below the surface.

(Continued on page 36)

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 2000. 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 in all fifty states, the Federal level as well as in Canada.

The 2000 schedule for the course **NORM Contamination in the Petroleum Industry** is

April 25-26, Tulsa, OK
Nov. 7-8, Tulsa, OK

For further information about the course, contact Joseph Goetz, OGCI. 1-800-821-5933, or contact Peter Gray, 501-646-5142, for information about the course content.

Comparison of NORM Rules by State (Continued)

Exemption for Contaminated Equipment

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

NOTES

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