HEALTH CONSULTATION

Coastal Radiation Services
St. Gabriel, Iberville Parish, Louisiana

CERCLIS NO. LA 0000605328

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U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
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I. BACKGROUND

Coastal Radiation Services (CRS) is the former site of a business that accepted radioactive materials from industrial clients. During the 1970's the soil was contaminated with radioactive cesium. Although the site was remediated by CRS site with EPA oversight, the remediation activity intensified health concerns among neighborhood residents. The residents of this community made these concerns known, and this health consultation addresses these concerns.

A. Site History

The CRS site is located at 6745 Bayou Paul Road in Sunshine, Iberville Parish, Louisiana, near Baton Rouge. CRS first occupied the site in October 1975 [1]. The Bayou Paul Road property, consists of an approximately one-half acre lot, a wood frame dwelling, a corrugated metal shed, and a carport.

The Division of Nuclear Energy of the Louisiana Department of Natural Resources (LDNR), issued CRS's radioactive materials license number LA-2857-L01 on or about June 25, 1973. CRS offered a number of services to the petrochemical industry in the Baton Rouge area, including survey and wipe testing of nuclear gauges, tracer studies, pipe scans, and removal and disposal of nuclear gauge sources. The radioactive sources were usually removed from their holders and consolidated in single containers for shipment to a licensed disposal site.

During the late 1970's, while working with radioactive sources, a leak occurred, contaminating the soil with cesium 137 (Cs 137), a radioactive isotope. Immediately following the spill, heavy rain ensued, which spread low-level radioactive contamination onto two adjacent residential properties. A LDNR inspector discovered the contamination in July 1979. The following month, neighbors and the tenant on-site were informed of the situation. The population within one mile of the site is 482 people (Figure 1).

The LDNR directed CRS to complete remediation of the site. In August 1979, CRS removed approximately 18 55-gallon drums of contaminated soil. In October 1979, CRS poured a concrete slab to provide shielding over the area immediately behind the shop and carport. This shielding did little to reduce the exposure rate in the neighbor's yard. It was discovered that much of the exposure was coming from Cs 137 that had moved by capillary action up fence posts. These were removed, which lowered the exposure rate. A large area of soil with low-level contamination remained at the site [2].

In July 1980, CRS indicated that the clean up was complete. However, LDNR's Division of Nuclear Energy inspector found the remediation to be insufficient and informed the business that clean up was not yet complete. LDNR kept CRS's radioactive materials license active, following the company's closure, and continued to monitor the site. Although CRS ceased to conduct business in the mid-1980's, the company officially went out of business in 1990.

In 1998, LDEQ initiated efforts to determine if CRS could be released from licensure. Release from licensure means that the property may be used for any purpose without restrictions. In early 2000, the Nuclear Regulatory Commission (NRC) reviewed the Coastal Radiation file. The NRC recommended that the Coastal Radiation site either be released for unrestricted use or that it be remediated to allow license termination. The Louisiana Department of Environmental Quality's (LDEQ) Surveillance Division initiated a reassessment to determine if the site met new, more stringent decommissioning standards. Dose assessment modeling indicated that, while radiation levels did not appear to exceed regulatory limits in effect at the time of the event, they exceeded the new decommissioning standard of 25 millirems (mrem) per year recently adopted by LDEQ.

The property owner performed additional site remediation during the summer of 2000. Despite the removal of five additional 55-gallon drums of soil by the property owner, LDEQ concluded that a more extensive cleanup was needed. In December, 2000, LDEQ referred the site to the Environmental Protection Agency (EPA) for assistance. In August 2001, EPA completed the Removal Assessment Report [2]. The EPA provided the required funding for the project under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), with the pursuit of future compensation form the PRPs, once identified. However, one of the PRPs declared bankruptcy. As the clean up was still desired, but all PRPs could not commit to fund 100% of the cleanup, EPA decided to go forward with a Fund lead removal action. The EPA identified several "potentially responsible parties" (PRPs) and will attempt to obtain cleanup funding from these parties. EPA anticipated that cleanup could begin in January 2002, if funding became available [3].

On September 28, 2001, EPA provided a whole body counter for the residents whose properties are affected. The machine measures the emission of gamma rays or x-rays from internally deposited radionuclides. The purpose of the whole body count was to help answer some of the residents'questions about their exposure to ionizing radiation. A health physicist was on hand to help interpret the data and answer health questions. All the individuals scanned showed no detection of cesium 137 in their bodies.

B. Regulatory Standards

The owners of CRS removed 54 55-gallon drums of soil from the site between August 1979 and July 1980. They also removed contaminated fence posts and poured 15 yards of concrete to cover contaminated soil. Following these actions, the LDEQ characterized the site and performed dose modeling calculations suggesting that a member of the public would most likely receive a radiation dose of 85 to 95 mrems per year from the CRS site. This level was within the regulatory standards in effect at the time of 500 mrems per year for the general public.

The permissible level of radiation exposure was subsequently lowered. In 1997, the Nuclear Regulatory Commission (NRC) promulgated the Radiological Criteria for License Termination (decommissioning rule). The NRC set the dose limit for a site where there would be unrestricted future use at 25 mrems per year. The EPA also sets cleanup levels for radioactive contamination. Unlike the NRC, the EPA determines clean-up levels based on cancer risk. The EPA sets cleanup levels to achieve a lifetime cancer risk of one additional cancer per 10,000 people exposed to one additional cancer per 1,000,000 people exposed (10^{-4} to 10^{-6}). The EPA found that the NRC clean-up standard yielded an unacceptable cancer risk. To achieve $3x10^{-4}$ increased lifetime cancer risk, the EPA set its clean-up standard at 15 mrem per year [6].

III. DISCUSSION

The surrounding community near the CRS site became concerned when the site was reassessed by the LDEQ in 2000. They worried about the health effects of past and current ionizing radiation exposure from the site. The Louisiana Department of Health and Hospitals/Office of Public Health/Section of Environmental Epidemiology and Toxicology (LDHH/OPH/SEET) was asked by a community representative what information the residents should provide to their personal health care providers in order to monitor for possible health effects from exposure to ionizing radiation.

In early 2000, the Louisiana Department of Environmental Quality (LDEQ) Surveillance Division initiated dose assessment modeling at the CRS site. In a report dated November 12, 2001, the Agency for Toxic Substances and Disease Registry (ATSDR) estimated that the maximum whole-body ionizing radiation dose was on the order of 0.001 millirems/year (10^{-5} milliSieverts/year) for adults and 0.1 mrem/year (10^{-3} mSv/year) for children based on radiation measurements taken in the residences [1]. A second report by ATSDR dated February 11, 2003, estimated that the maximum whole-body ionizing radiation dose was 0.035 millirem/year [2]. For comparison, the average annual radiation exposure for an individual in the United States is 360 mrem/year (3.6 mSv/year)[3]. Residents of Louisiana receive approximately 92 mrem/year (0.92 mSv/year) of radiation exposure from natural sources [3]. The Nuclear Regulatory Commission (NRC) requires that its licensees limit maximum radiation exposure to individuals members of the public to 100 mrem/year (1 mSv) per year [4]. In line with NRC requirements and recommendations of national and international scientific organizations, the Agency for Toxic Substances and Disease Registry's (ATSDR's) Minimal Risk Level is also100 mrem/year above background levels [3]. Therefore, the additional estimated maximum ionizing radiation exposure to the residents of the St. Gabriel community is well within accepted guidelines for ionizing radiation exposure to the public.

The majority of research and information available on the health effects of ionizing radiation comes from studies of acute high dose, high dose rate exposures in Japanese atomic bomb survivors, radiotherapy patients and persons exposed during the Chernobyl accident. The two main health effects of radiation that have been extensively studied are cancer induction and genetic injury. Radiation-associated cancer risk estimates have been calculated by the National Research Council's Committee on the Biological Effects of Ionizing Radiations (BEIR) for a number of different organs and tissues including bone marrow (leukemia), breast, thyroid, lung and gastrointestinal organs [5]. Based on the evidence from high dose, high dose rate radiation exposure, BEIR estimates that the population-weighted average lifetime excess risk of death from cancer following an acute whole-body dose equivalent of 0.1 Sv (10 mrem) is approximately 0.8% [5]. The committee cautions, however, that risk estimates become more uncertain when applied to very low exposure doses, and the lifetime risk is likely 50% or less of that reported for an acute dose when the accumulation of the same dose is over longer time periods (months to years) [5]. The maximum ATSDR dose estimates to the residents of St. Gabriel are a hundred-fold to a thousand-fold less than the low dose estimate of 0.1 Sv (10 mrem) used in the BEIR report. In populations with long-term exposure to elevated low-level radiation from natural sources, studies have not demonstrated consistent or conclusive evidence of an associated increased risk of cancer [5].

Currently, there is very little direct data on the health effects of chronic, low level exposure to ionizing radiation. However, there is considerable interest and a growing body of literature on the application of biomarkers to measure chronic, low levels of ionizing radiation exposure and predict risk. The World Health Organization defines a biomarker as “any substance, structure, or process that can be measured in the body or its products and influence or predict the incidence of outcome or disease” [6]. There are four main ionizing radiation biomarker classes currently under investigation including chromosomal aberrations , DNA adducts, gene expression and encoded proteins, and DNA mutations [7]. Chromosome aberration-based assays are considered the gold standard of ionizing radiation biomarkers [7]. Although chromosome aberrations can be measured and are an intermediate point in the cancer pathway, their predictive value is severely limited. The literature has failed to establish a dose-effect relationship between chromosome aberrations and exposure to low levels of ionizing radiation [8]. Recent epidemiological studies have suggested that there is an increased risk of cancer in healthy individuals with high levels of chromosome aberrations [9, 10, 11]. However, from these studies, it is impossible to determine whether chromosome aberrations are predictive of cancer because they are a result of past exposure to carcinogens, reflective of individual genetic susceptibility or due to other potentially confounding factors [12].

Two factors that appear to have the greatest influence on the frequency of chromosomal aberrations are age and smoking. The frequency of chromosomal aberrations rises with increasing age, this is termed the “age effect” [8]. The age effect has been confirmed by a number of studies including the recent Human Micronucleus Project that collected data on almost 7000 subjects [8, 13]. It has been suggested in the literature that the “age effect” may reflect an accumulation of DNA damage and a subsequent increase in chromosome instability as a result of an age-related decrease in DNA-repair capacity [8]. Studies in Japanese atomic bomb survivors have demonstrated that the number of excess cancers per unit dose of ionizing radiation exposure increases with age suggesting that older individuals are potentially more susceptible to the effects of ionizing radiation [5]. The second factor that appears to increase the frequency of chromosomal aberrations is cigarette smoking [14]. Smoking is an important cause of cancers of the lung, larnyx, pharnyx, esophagus, bladder, kidney and pancreas in the general population. A recent study found that smoking increased the frequency of DNA damage induced by ionizing radiation in a group of hospitals workers occupationally exposed to low levels of ionizing radiation [8]. Although the development and validation of biomarkers for low levels of ionizing radiation is currently an intense study area, it is still in the experimental stages; commercial testing is not yet available.

A review of the potential health effects of chronic, low levels of ionizing radiation in a community would be incomplete without mention of the potential psychological health effects. According to the National Research Council, “Usually the perception of risk from radiation exposure is much greater that the actual risks......” but even the perception of risk can induce a significant stress response [15]. The Three Mile Island nuclear reactor accident in 1979 caused no radiation exposure above background levels to residents of the community [16]. However, the perceived risk from radiation exposure produced long-term emotional, behavioral and physiologic signs of stress in the community [16]. Four years after the Three Mile Island accident, residents in the community had an increase in psychosomatic symptoms, depression, palliative medication use, catecholamine production and blood pressure compared with a control group [17]. Therefore, it is important to consider and address actual as well as perceived exposure risks when conducting health assessments on either the individual or community level. Health care providers should consider both the potential physical and neuropsychological effects in the evaluation of patients exposed to chronic, low levels of ionizing radiation.

A. Cesium Toxicity

Cesium (Cs) is a naturally occurring element found in rocks, soil, and dust at low concentrations. Cesium137 (Cs137) is a radioactive isotope (form) of cesium that is produced by the fission of uranium in nuclear reactor fuel elements. Cs137 decays to barium137, which is not radioactive. As Cs137 decays, beta and gamma radiation are given off. The half-life of Cs137 is about 30 years [5].

As with other radioactive isotopes, the energy released by Cs137 can result in significant damage to living cells. The most important exposure routes for Cs137 are external exposure to the radiation released and ingestion of radioactive cesium-contaminated food sources. Inhalation and dermal exposure routes may also present a health hazard.

IV. CHILD HEALTH CONSIDERATIONS

As part this Health Consultation, the Child Health Consideration section points out whether any site-related exposures are of particular concern for children. Children are not small adults. Young children are especially sensitive to the health effects of environmental contaminants since they have greater possible exposure. Children are closer to the ground and often play in the dirt and are more likely to eat soil by putting their hands in their mouths. These childhood behavioral traits could result in ingestion of Cs 137 contaminated soil in quantities which are greater than those an adult would ingest. The levels currently present at the Coastal Radiation Services site pose no health risk to children who may live nearby or trespass onto the site. The contaminated soils once present have been removed in the EPA sponsored Removal Action.

V. CONCLUSIONS/RECOMMENDATIONS

Radiation exposure from the Coastal Radiation Services site (CRS) is below the background dose received by the general public. No health effects which are attributable to the CRS site can be measured in residents.

1. The Office of Public Health, Section of Environmental Epidemiology and Toxicology (OPH) recommends no specific questions which residents should address to their personal physicians.

OPH recommends that concerned residents should consult their physician, and maintain routine health care practices.

2. All persons should have regular screening examinations in accordance with the United States Preventive Services Task Force's (USPSTF) Guide to Clinical Preventive Services [18]. Screening for high blood pressure, depression and cancer (breast, cervical, colorectal, prostate and skin) is appropriate for residents of the St. Gabriel community and recommended by USPSTF.

3. All persons who currently smoke should discontinue tobacco use. There are a number of resources available for smoking cessation including health care providers, local chapters of national organizations such as the American Cancer Society and community-sponsored events and programs.

VI. PUBLIC HEALTH ACTION PLAN

Actions Planned

1. The Office of Public Health will provide this Health Consultation to the community.
2. The Office of Public Health will provide this Health Consultation to the Environmental Protection Agency and the Louisiana Department of Environmental Quality.
3. The Office of Public Health will respond to any further public health questions that the community may have, and address them appropriately.

List of Acronyms and Definitions of Selected Terms

ATSDR
Agency for Toxic Substances and Disease Registry

Beta Particles
An elementary charged particle emitted from a nucleus during radioactive decay. *Beta particles* may be stopped by thin sheets of metal or plastic.

Capillary Action
The movement of a liquid, such as water, up thin tubes and fibers due to molecular forces called capillary forces.

CERCLA
The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, also known as Superfund. This is the legislation that mandates ATSDR public health assessment activities.

Cesium 137
A radioactive form of cesium.

CRS
Coastal Radiation Services

Contaminant
Any substance or material that enters a system (the environment, human body, food, etc.) where it is not normally found.

Decommission
The process of safely removing a facility from service followed by reducing residual radioactivity to a level that permits the release of the property for unrestricted and, under certain conditions, restricted use.

Dermal
Referring to the skin. *Dermal* absorption means absorption through the skin.

Dose
The amount of a substance to which a person is exposed. *Dose* often takes body weight into account.

Environmental Contamination
The presence of hazardous substances in the environment. From the public health perspective, *environmental contamination* is addressed when it potentially affects the health and quality of life of people living and working near the contamination.

EPA
United States Environmental Protection Agency. The federal agency that develops and enforces environmental laws to protect the environment and the public's health.

Exposure
Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). *Exposure* may be short term (acute) or long term (chronic).

Gamma Rays
High-energy, short wavelength, electromagnetic radiation emitted from the nucleus. They are true rays of energy in contrast to alpha and beta radiation. The properties are similar to x-rays and

electromagnetic waves. They are the most penetrating waves and are best stopped by dense materials, such as lead or depleted uranium.

Half-life
The time required for a radioactive substance to lose 50% of its activity by decay. Each radio-nuclide has a unique physical half-life.

Health Consultation
A response to a specific question or request for information pertaining to a hazardous substance or facility (which includes waste sites). It often contains a time-critical element that necessitates a rapid response; therefore, it is a more limited response than an assessment.

Inhalation
Breathing. Exposure may occur from inhaling contaminants because they can be deposited in the lungs and absorbed into the blood

Isotope
One of two or more atoms with the same number of protons, but different numbers of neutrons in their nuclei. Isotopes have very nearly the same chemical properties, but often different physical properties.

LDEQ
Louisiana Department of Environmental Quality

LSU
Louisiana State University

Millirems
Millirem. One thousandth of a rem. (1 mrem = 10^{-3} rem)

NRC
The Nuclear Regulatory Commission. This is an independent agency established by the U.S. Congress under the Energy Reorganization Act of 1974 to ensure adequate protection of the public health and safety, the common defense and security, and the environment in the use of nuclear materials in the United States. The NRC's scope of responsibility includes regulation of 1.) commercial nuclear power reactors; nonpower research, test, and training reactors, 2.) fuel cycle facilities; medical, academic, and industrial uses of nuclear materials, and 3.) the transport, storage, and disposal of nuclear materials and waste

Radioactive
The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays, from the nucleus of an unstable isotope.

Rem
Radiation Equivalents in Man, a unit of biological dose

Superfund

Another name for the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), which created ATSDR.

CERTIFICATION

This Coastal Radiation health consultation was prepared by the Louisiana Department of Health and Hospitals under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

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The Division of Health Assessment and Consultation, ATSDR has reviewed this public health consultation and concurs with the findings.

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REFERENCES

1. ATSDR. Health Consultation for Coastal Radiation Services. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, February 11, 2003.

2. ATSDR. Toxicological Profile for Ionizing Radiation. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, 1999.

3. National Regulatory Commission (NRC). Fact Sheet on Biological Effects of Radiation. Washington DC: NRC, January 2003.

4. Committee on the Biological Effects of Ionizing Radiations, National Research Council. Health Effects of Exposure to Low Levels of Ionizing Radiation: BEIR V. Washington DC, National Academies Press, 1990.

5. World Health Organization (WHO). Biomarkers in Risk Assessment: Validity and Validation. Geneva: WHO, 2001.

6. Blakely WF, Brooks AL, Lofts RS, Van der Schans GP, Voisin P. Overiew of Low-Level Radiation Exposure Assessment: Biodosimetry. Mil Med 2002:167 (1 Suppl):20-4.

7. Maffei F, Angelini S, Forti GC, Lodi V, Violante FS, Mattioli S, Hrelia P., Micronuclei Frequencies in Hospital Workers Occupationally Exposed to Low Levels of Ionizing Radiation: Influence of Smoking Status and Other Factors. Mutagenesis 2002:17:405-409.

8. Hagmar L, Brogger A, Hansteen IL, Heim S, Hogstedt B, Knudsen L et al. Cancer Risk in Humans Predicted by Increased Levels of Chromosome Aberrations in Lymphocytes: Nordic Study Group on the Health Risk of Chromosomal Damage. Cancer Res 1994:54:2919-2922.

9. Bonassi S, Abbondandolo A, Camurri L, DalPra L, De Ferrair M, Degrassi F, et al. Are Chromosome Aberrations in Circulating Lymphocytes Predictive of a Future Cancer Onset in Humans? Prelininary Results of an Italian Cohort Study. Cancer Genet Cytogenet 1995:79:133-135.

10. Hagmar L, Bonassi S, Stromberg U, Brogger A, Knudsen L, Norppa H, et al. Chromosomal Aberrations in Lymphocytes Predict Human Cancer: A Report from the Europena Study Group on Cytogenetic Biomarkers and Health (ESCH). Cancer Res 1998: 58:4117-4121.

11. Bonassi S, Hagmar L, Stromberg U, Montagud AH, Tinnerberg H, Forni A, et al. Chromosomal Aberrations in Lymphocytes Predict Human Cancer Independently of Exposure to Carcinogenc. Cancer Res 2000: 60:1619-1625.

12. Bonassi S, Fenech M, Lando C, Lin Y, Ceppi M, Chang WP, et al. Human MicroNucleus Project: International Database Comparison for Results with the Cytokinesisblock

Micronucleus Assay in Human Lymphocytes. Part I. Effect of Laboratory Protocol Scoring Criteria and Host Factors on the Frequency of Micronucleui. Environ Mol Mutagen 2001:37:31-45.

13. Moller P, Knudsen LE, Loft S, Wallin H., The Comet Assay as a Rapid Test in Biomonitoring Occupational Exposure to DAN-Damaging Agents and Effect of Confounding Factors. Cancer Epidemiology, Biomarkers & Prevention 2002:9:1005-1015.

14. NRC. Potential Radiation Exposure in Military Operations, Washington DC, National Academies Press, 1996.

15. Landauer MR, Young RW, Hawley AL. Physiological and Psychological Impact of Low-Level Radiation: An Overview. Mil Med 2002: 167 (1 Suppl):1410142.

16. Collins DL. Human Responses to the Threat of or Exposure to Ionizing Radiation at Three Mile Island, Pennsylvania, and Goiania, Brazil. Mil Med 2002:167 (1 Suppl):137-138.

17. United States Preventive Services Task Force. Clinician’s Handbook of Preventive Services, Third Edition. Washington DC, Office of Disease Prevention and Health Promotion, 2000.

Figure 1. Coastal Radiation Services Intro Map.
(BILL HENRIQUES HAS ALREADY MADE A DEMOGRAPHICS MAP)