Public Health Assessment for

PUBLIC HEALTH ASSESSMENT ADDENDUM
STAUFFER CHEMICAL COMPANY (TARPON SPRINGS)
TARPON SPRINGS, PINELLAS COUNTY, FLORIDA
CERCLIS NO. FLD010596013
AUGUST 6, 1999

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This public health assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H), for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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TARPON SPRING, PINELLAS COUNTY, FLORIDA

CERCLIS NO. FLD010596013

Prepared by:

Energy Section
Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, is an agency of the U.S. Public Health Service. It was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. (The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by the EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists then evaluate whether or not there will be any harmful effects from these exposures. The report focuses on public health, or the health impact on the community as a whole, rather than on individual risks. Again, ATSDR generally makes use of existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further research studies are needed.

Conclusions: The report presents conclusions about the level of a health threat, if any, posed by a site and recommends ways to stop or reduce exposure in its public health action plan. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by the EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-56), Atlanta, GA 30333.

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SUMMARY

From 1947 to 1981, the Stauffer Chemical Company in Tarpon Springs, Florida, made elemental phosphorus from phosphate ore. While the plant was in operation, phosphate slag was transported off-site and used as aggregate in road bedding, road and driveway paving, and in concrete structures. The extent of the distribution could not be determined. Residents in the area expressed concern about possible adverse health effects resulting from exposure to radium and heavy metals leaching from phosphate slag that was used in nearby roads and buildings. Besides radium, other contaminants of concern to residents were arsenic, asbestos, uranium, radon, and ionizing radiation.

There is elevated background radiation from natural radium in phosphate slag and aggregate, but exposures are not expected to result in any adverse health outcomes.

Phosphate slag contains concentrations of metals above background levels. However, based on current epidemiological and medical information the levels are not likely to represent a public health hazard. Combined exposures from roads and driveways are not a health threat. The ATSDR recommends that public health education be provided, to help the public better understand that there is no public health hazard posed by the phosphate slag.

BACKGROUND

In February 1998, the Agency for Toxic Substances and Disease Registry (ATSDR) received a petition from a Tarpon Springs, Florida, resident. The person requested that the agency investigate health problems that might be associated with exposure to slag materials used in residential areas of Tarpon Springs. Since then, the ATSDR has responded to letters from several other residents. The U.S. Environmental Protection Agency (EPA), Region IV also requested that the ATSDR review the sampling data taken at several vicinity properties near the Stauffer Superfund site in Tarpon Springs. The EPA asked the ATSDR to review chemical and radiological sampling data of residential slag, to evaluate exposure scenarios, to provide radiological dose estimates, and to make recommendations for protection of public health.

Since receiving letters from concerned Tarpon Springs residents, ATSDR staff members have begun investigating residents' health concerns and possible associations between those concerns and exposures to hazardous substances.

A. Site Description and History

From 1947 to 1981, the Stauffer Chemical Company (which operated under different ownership until 1960) made elemental phosphorus from phosphate ore using an arc furnace process. The processed ore was shipped off-site to produce agricultural products, food-grade phosphates, and flame retardants. While the chemical plant operated, waste products (i.e., slag) were disposed of on the plant property, shipped off-site by rail, and given to local residents to be used as fill and aggregate.

The Stauffer plant was added to the EPA Superfund list in 1994 because of pollution on the site. Superfund is a federal program for finding and cleaning up hazardous waste sites in this country. Since 1994, the EPA has been working to clean up the Stauffer site. The EPA is testing and monitoring the soil, water, and air at the site and at vicinity properties to protect nearby residents against health problems that might result from exposure to hazardous waste.

B. Site Visit

In May 1998, ATSDR staff members visited Tarpon Springs to meet with residents and to gather more information. Staff members addressed residents' questions. ATSDR and EPA Region IV personnel visited several vicinity properties in Tarpon Springs and Holiday, Florida. They saw the Stauffer Chemical Superfund site from the site boundary including the Anclote River. During a boat tour on the Anclote River, the ATSDR and the EPA were shown where slag from the site was used to fill in an inlet on site property.

In August 1998, EPA Region IV personnel and staff from EPA's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama, took samples of building materials and roads and performed radiological surveys of several vicinity properties.

C. Demographics, Land Use and Natural Resources

The City of Tarpon Springs is in Pinellas County, Florida. The community is near the Anclote River, about 1.6 miles east of the Gulf of Mexico. Gulfside Elementary School is directly across the street from the Stauffer site and Tarpon Springs Middle and High Schools are also in close proximity.

According to 1990 census data (1), 9,231 people live within a one-mile radius of the site. About 97% of the population is white and 2.2% are black, with most being middle income level. A hospital, a nursing home, and a children's group home are within one mile of the site. There are about 100 private wells within this same area. The color maps on the following page give a graphical representation of the demographic data (see figure 1).

D. Health Outcome Data

Evaluation of available health outcome data did not find any elevated mortality rates for leukemia, bone cancer, or respiratory diseases. Rates for Pasco and Pinellas Counties were below the state averages for both respiratory disease and childhood leukemia and bone cancers.

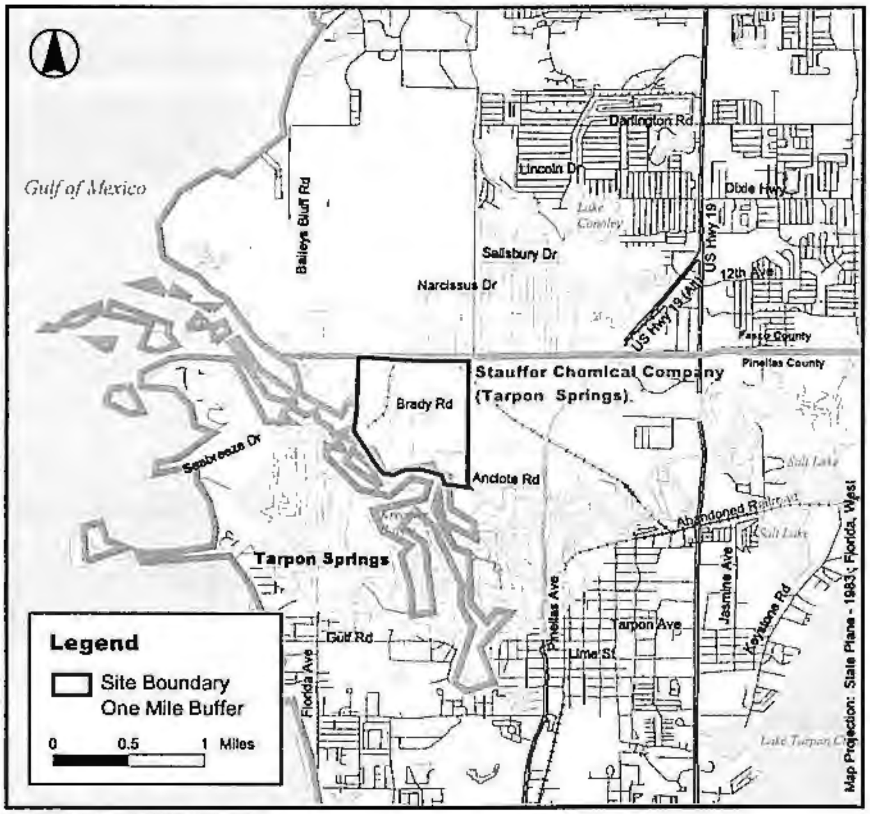
Mortality data were analyzed for various respiratory diseases (ICD Codes 460 to 519.9) and for childhood radiogenic cancers (ICD Codes 204 to 204.9) in Florida counties surrounding the Stauffer site. Respiratory diseases were looked at, because of the dusts emitted from Stauffer Chemical when it was operating. The ATSDR used the *Wide-ranging ONline Data for Epidemiologic Research (WONDER)* system, which is a computer database designed by the Information Resources Management Office, Centers for Disease Control and Prevention (CDC), Public Health Service. The mortality section of the database provided information for comparing the rates of the county with rates for the state and the rest of the country.

Stauffer Chemical Company (Tarpon Springs)

INTRO MAP

Tarpon Springs, Florida

CERCLIS No. FLD010596013



Base Map Source: 1995 TIGER/Line Files

Pinellas County, Florida

Demographic Statistics Within One Mile of Site*	
Total Population	9231
White	8936
Black	208
American Indian, Eskimo, Aleut	26
Asian or Pacific Islander	35
Other Race	23
Hispanic Origin	208
Children Aged 6 and Younger	549
Adults Aged 65 and Older	2940
Females Aged 15 - 44	1465
Total Housing Units	4906

Demographics Statistics Source: 1990 U.S. Census
*Calculated using an area-proportion spatial analysis technique

Population Density

Source: 1990 U.S. Census

Children 6 Years and Younger

Source: 1990 U.S. Census

Adults 65 Years and Older

Source: 1990 U.S. Census

Females Aged 15 - 44

Source: 1990 U.S. Census

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COMMUNITY HEALTH CONCERNS

Residents from Tarpon Springs, and Holiday, Florida expressed concern about adverse health effects resulting from exposure to radium and heavy metals leaching from phosphate slag that was used in nearby roads and buildings. Besides radium, other contaminants of concern to residents were arsenic, beryllium, uranium, radon, and ionizing radiation.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. Contamination

The ATSDR reviewed the report of the radiological survey that EPA Region IV conducted during the week of August 23, 1998 (2). The gamma radiation surveys were taken at four residences near the Stauffer Chemical Superfund site in Tarpon Springs, Florida. Slag and soil samples were taken at 10 residences and chemically analyzed (3) to determine if there was a toxicological risk to the public and also to compare the contaminants in the off site slag to those at the Stauffer site. Slag appeared to be in a sintered form (i.e., a glass like material), consistent with an arc furnace extraction process. Samples were analyzed for aluminum, antimony, arsenic, asbestos, barium, beryllium, cadmium, chromium, cobalt, copper, iron, manganese, mercury, nickel, radium, selenium, silver, thallium, vanadium, fluoride, and zinc.

ATSDR staff also reviewed relevant tests conducted by EPA representatives (2,3) and health-related reports issued by the Florida Department of Health (FDOH). The FDOH, through a cooperative agreement with the ATSDR, has issued a public health assessment for the Stauffer site (4) and a health consultation for the Gulfside Elementary School in Holiday, Florida (5).

Appendix A contains the radiological survey and sampling data from the site visit (Stauffer Chemical Vicinity Properties) during the week of August 23, 1998.

Static gamma radiation surveys were taken in four residences using a pressurized ion chamber (PIC). This instrument is calibrated in microrad per hour (μrad/hr) and was provided and operated by the EPA's National Air, Radiation and Environmental Laboratory (NAREL) . Comparison surveys were taken at the same locations with a Bicron Micro Rem meter, S/N B792W, calibration date of August 4, 1998. Measurements were taken at both waist level (normal standard for exposure surveys) and ground level for comparison purposes.

The hurricane proof construction style of residence #1 (see Table 1) is different from that of any other home encountered. The floors and some walls on both levels are poured concrete that use phosphate slag as aggregate. This resulted in the basement floors having more than twice the gamma dose rate of the upstairs living space.

B. Quality Assurance and Quality Control

In preparing this public health assessment (PHA), the ATSDR relied on the information provided in the referenced documents. The agency assumed that adequate quality assurance and quality control measures were followed with regard to chain-of-authority, laboratory procedures, and data reporting. The validity of the analyses and the conclusions drawn in this document was determined by the availability and reliability of the referenced information.

PATHWAYS ANALYSIS

As of June, 1998, there was a completed exposure pathway from ionizing radiation from elevated background, but not at levels expected to cause adverse health effects. EPA samples of selected residences found that driveways, yard fill, home foundations, and other concrete structures contained phosphate slag with measurable concentrations of the natural radium isotope Ra-226 (3). Phosphate slag is a naturally-occurring radioactive material, not a man-made radioactive material or a licensed radioactive material.

Radiation dose measurements in several homes were elevated compared to background measurements, but not sufficient to represent a health hazard. The normal background for the Tarpon Springs area was about 60 millirem per year (mrem/yr), excluding the contribution from radon. If the dose from radon for this part of Florida is included, the annual background dose is about 160 mrem/yr. Florida has a low background dose compared to Denver, Colorado, which is about 300 millirem (including the contribution to total dose from radon). The International Council on Radiation Protection (ICRP) (6) and the National Council on Radiation Protection and Measurements (NCRP) (8) both consider phosphate slag in building materials to be part of background.

The NCRP, in its report number 116, on page 50, gives the average dose from background radiation (excluding contribution from radon) to be 100 millirem per year and recommends that doses from background should be remediated if they exceed 500 millirem per year (8). To put this in perspective, the ICRP recommends that radiation doses to the public not exceed 500 millirem in any 5 year period and should be less than 100 millirem per year over a lifetime, excluding doses from background (i.e., natural sources like phosphate slag), diagnostic (e.g., x-rays) and other medical exposures(6). The lowest observed adverse effect level (LOAEL) from ionizing radiation is from 10,000 to 50,000 millirem in one exposure and is seen as a slight decrease in blood cell count (7).

Radon samples in homes were all below EPA's action level of 4 pCi/L. There was no radon gas coming from slag containing radium. The lack of radon would be expected from the glass-like character of the slag. Although phosphate slag contains heavy metals, leach testing of the samples taken by EPA, did not find measurable heavy metals. The glass-like property of the slag would also explain why heavy metals were not detected in leachate.

We made theoretical radiation dose calculations for the four properties in which gamma measurements were taken. We assumed a more conservative (high) occupancy factor of 18 hours per day in residence #1 and one hour on a slag aggregate driveway for 350 days per year, because of the young child present. For the other residences sampled, we assumed an occupancy factor of 17 hours in parts of the residence containing slag aggregate for 350 days per year. The calculated doses from building materials ranged from a high of 210 millirem per year (mrem/yr) at residence #1 (see Table 1 in Appendix A) to a low of 41 mrem/yr at residence #3 (see Table 3 in Appendix A). No infants or elderly individuals, who might be expected to be home more than 18 hours per day, lived in the homes with the greatest amounts of slag aggregate. Using a conservative exposure model for a maximally exposed child in the most affected home, the expected annual dose was well below the NCRP's remediation recommendation of 500 mrem/yr (8).

PUBLIC HEALTH IMPLICATIONS

All the radium levels sampled at off site residences and the associated gamma radiation were elevated above the local average for background radiation. The National Council on Radiation Protection and Measurements (NCRP), in its report number 116 on page 50, states that some building materials can contain naturally occurring radioactive materials and should only be remediated if annual doses exceed 500 millirem per year (8). The lowest observed adverse effect level (LOAEL) from ionizing radiation is from 10,000 to 50,000 millirem in a short period of time (i.e., less than a week) and is seen as a slight decrease in blood cell count (7). (Note: A millirem is equivalent to a millirad for gamma radiation.)

Of the four homes sampled in the Tarpon Springs area, only one exceeded 100 millirem per year, from structural building materials. Residence #1 had elevated radiation levels, especially in the basement. Using a conservative scenario, the annual dose to a young child living in a basement bedroom could receive about 210 mrem/yr additional background dose, which is well below the NCRP's 500 mrem/yr guideline (8).

The ICRP and NCRP recommendations are very conservative and are a factor of 100 below the LOAEL for acute exposure to ionizing radiation. Even though the total dose including radon would be 310 mrem/yr, this is still roughly the national average background dose in the United States of 300 mrem/yr (9). No adverse health effects would be expected from residing in the most affected home.

Phosphate slag at sampled vicinity properties does not appear to contain sufficient heavy metals to represent a public health hazard, based on current medical, epidemiological and toxicological information. For non-radioactive chemicals and metals, the ATSDR uses comparison values (contaminant concentrations in specific media and for specific exposure routes believed to be without risk of adverse health effects) to select contaminants for further evaluation. The ATSDR and other agencies have developed the values to provide guidelines for estimating media contaminant concentrations that are not likely to cause adverse health effects, given a standard daily ingestion rate and standard body weight. Table 5 lists environmental media exposure guidelines (EMEGs) and reference media exposure guidelines (RMEGs).

Many of these values have been derived from animal studies. Health effects are related not only to the exposure dose, but to the route of entry into the body and the amount of chemical absorbed by the body. Several comparison values might be available for a specific contaminant. To protect the most sensitive segment of the population, the ATSDR generally selects the comparison value that uses the most conservative exposure assumptions.

Natural Background Radiation

Natural radiation and naturally occurring radioactive materials in the environment provide the major source of radiation exposure to the public. For this reason, natural background radiation is often used as a comparison for man-made sources of ionizing radiation. Background radiation comes from cosmic sources, naturally occurring radioactive materials including radon, and global fallout as it exists in the environment from testing of nuclear explosive devices. Although numerous epidemiological studies have attempted to relate the health effects to exposures from elevated natural radiation, none has provided definitive results (10).

The average annual effective dose in the United States population from natural background radiation circa 1980 - 82 was 300 millirem per year (mrem/yr). Radon and its decay products account for roughly 200 mrem/yr. Cosmic radiation contributes 26 mrem/yr at sea-level and greater than 50 mrem/yr in Denver. Terrestrial gamma radiation from the earth and building material contributes an average of 28 mrem/yr, but in certain areas with uranium or phosphate ore bodies and coastal areas with deposits of monazite sands, the contribution can be as high as 2000 mrem/yr. The contribution from internal radioactive materials, such as potassium-40 and polonium-210, is about 39 mrem/yr (9).

Special Considerations of Women and Children

Radiation doses are calculated at ½ meter (20 inches) from the floor to better estimate the dose to children. Although there is elevated background radiation from radium-containing slag and aggregate, the dose to children is approximately the national average background dose of 300 mrem per year and is not expected to result in any adverse health effects. Phosphate slag at sampled vicinity properties does not appear to contain sufficient heavy metals to represent a health hazard to women or children, based on current medical, epidemiological and toxicological information.

CONCLUSIONS

1. Phosphate slag from the Stauffer Chemical Superfund site reportedly has been used as concrete aggregate in homes, roads and roadbeds in the Tarpon Springs and Holiday, Florida vicinity.

2. Although there is elevated background radiation from radium-containing slag and aggregate, the total background dose to a maximally exposed child in residence #1 is roughly the national average background dose of 300 mrem per year.

3. Annual background dose contribution from building materials to the maximally exposed child in residence #1 does not exceed the NCRP's recommended limit of 500 mrem per year.

4. Phosphate slag at sampled vicinity properties, does not appear to contain sufficient leachable heavy metals to represent a public health hazard, based on current medical, epidemiological and toxicological information.

5. Combined exposures from driveways and roads containing phosphate slag are not a health threat.

RECOMMENDATION

The ATSDR recommends that public health education be provided to help the public better understand that there is currently no general public health hazard posed by the phosphate slag and to provide information to community members on the environmental health effects presented in the Stauffer Chemical Vicinity Properties public health assessment addendum.

PUBLIC HEALTH ACTION PLAN

The public health action plan for the Stauffer Chemical Vicinity Properties contains a description of actions to be taken by the Agency for Toxic Substances and Disease Registry (ATSDR) and other government agencies at and in the vicinity of the site after the completion of this public health assessment. The purpose of this Public Health Action Plan is to ensure that this public health assessment not only identifies public health hazards but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment.

Upon request from the public, the Florida Department of Health (FDOH) will develop and implement an environmental health education program to help community members understand the potential for past exposure and to provide information on assessing any adverse health occurrences that might be related to phosphate slag.

PREPARER OF REPORT

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REFERENCES

1. Bureau of the Census, U.S. Department of Commerce, Washington, DC, 1990 Census Data Files.

2. Memorandum dated September 2, 1998, from Rick Button, Health Physicist to John Blanchard, Remedial Project Manager, US EPA. Report on radiological surveys conducted and observations for the offsite Stauffer Chemical visit of August, 1998 in Tarpon Springs, FL.

3. Memorandum dated September 17, 1998, from John Griggs, Chief Monitoring and Analytical Services Branch to John Blanchard, US EPA Region IV, Waste Division. Radiochemical results for Tarpon Springs Samples.

4. Florida Department of Health. Preliminary Public Health Assessment for Stauffer Chemical Company/Tarpon Springs, Tarpon Springs, Pinellas County, Florida. FDOH: Tallahassee, August 4, 1993.

5. Florida Department of Health, Bureau of Environmental Toxicology, Under Cooperative Agreement with the Agency for Toxic Substances and Disease Registry, Health Consultation for the Gulfside Elementary School, Holiday, Florida dated June 18, 1998.

6. ICRP (1990). International Commission on Radiological Protection (ICRP) Recommendations of the International Commission on Radiological Protection. ICRP Publication 60. New York: Pergamon Press. 1990.

7. National Council on Radiation Protection and Measurements. Influence of Dose and Its Distribution in Time on Dose-Response Relationships for Low-LET Radiations, NCRP Report No. 64. NCRP: Bethesda, 1980.

8. National Council on Radiation Protection and Measurements. Limitation of Exposure to Ionizing Radiation, NCRP Report No. 116. NCRP: Bethesda, March 31, 1993.

9. National Council on Radiation Protection and Measurements. Exposure of the Population in the United States and Canada from Natural Background Radiation, NCRP Report No. 94. NCRP: Bethesda, December 30, 1987.

10. National Council on Radiation Protection and Measurements. Ionizing Radiation Exposure of the Population in the United States, NCRP Report No. 93. NCRP: Bethesda, September 1, 1987.

Appendix A Dose Estimation

The observed radiation background for similar residences was 6-7 microrad per hour (µrad/hr). Average dose rates in affected areas ranged from 15.4 to 39.1 µrad/hr. One thousand µrads are equivalent to one millirem for gamma radiation. The National Council on Radiation Protection and Measurements (NCRP) states that some building materials can contain naturally occurring radioactive materials and should only be remediated if annual doses exceed 500 millirem per year (8).

Table 1 Stauffer Chemical Vicinity Properties - Residence 1

Location:	Residence 1	µrad/hr (waist level)	µrad/hr ground level	Average
#1	basement	42	49	45
#2	basement	38	44	41
#3	basement	43	48	46
#4	basement	47	51	49
#5	basement	44	51	47
#6	basement	31	41	36
#7	basement	45	46	45
#8	basement	30	44	37
#9	basement	46	53	49
#10	basement	42	48	45
#11	bedroom	31	41	36
#12	bedroom	30	39	35
#13	1st floor	14	17	16
#14	1st floor	20	28	24
#15	1st floor	10	9	10
#16	1st floor	19	26	22
#17	1st floor	26	29	27
#18	1st floor	25	31	28
#19	1st floor	11	12	11
#20	1st floor	9	11	10
#21	driveway	29	38	34
#22	driveway	29	39	34
#23	driveway	60	73	67
Average	living areas	16.7 (1st floor)		
Annual Dose	from Building Materials (mrem)			210

Note: One thousand microrad (µrad) are equivalent to one millirem (mrem) for gamma radiation.

To calculate an Annual Dose, because there were small children in the home, took an average of the one meter and ground level measurements, then for each area (e.g. bedroom, 1st floor) took an average of readings, then subtracted the local background of 6 µrad/hr and assumed 12 hours per day in the bedroom, 5 hours in the basement, one hour on the first floor and one hour on the driveway for 350 days per year.

Table 2 Stauffer Chemical Vicinity Properties - Residence 2

Location:	Residence 2	µrad/hr (waist level)
#1	bedroom	20
#2	bedroom	21
#3	bedroom	20
#4	bedroom	22
#5	bedroom	26
#6	bedroom	27
#7	bedroom	28
#8	bedroom	21
#9	bedroom	25
#10	bedroom	27
#11	bedroom	29
#12	bedroom	27
#13	bedroom	21
Annual Dose	from building materials	76 (mrem)

Note: One thousand microrad (µrad) are equivalent to one millirem (mrem) for gamma radiation. To calculate an Annual Dose, averaged the readings, then subtracted local background of 6 µrad/hr and assumed 12 hours per day in the bedroom and 5 hours in other parts of the house for 350 days per year.

Table 3 Stauffer Chemical Vicinity Properties - Residence 3

Location:	Residence 3	µrad/hr (waist level)
#1	o/s slab	25
#2	o/s slab	25
#3	o/s slab	19
#4	o/s slab	19
#5	o/s slab	22
#6	o/s slab	29
#7	o/s slab	22
#8	o/s slab	23
#9	living room	22
#10	living room	19
#11	living room	19
#12	living room	20
#13	kitchen	20
#14	kitchen	19
#15	bathroom	15
#16	o/s bathroom	15
#17	side bedroom	8
#18	back left bedroom	7
#19	back right bedroom	15
#20	back right bed	7
Annual Dose	from building materials	41 (mrem)

Note: One thousand microrad (µrad) are equivalent to one millirem (mrem) for gamma radiation. To calculate an Annual Dose subtracted local background of 6 µrad/hr, then for each area (e.g. bedroom) took an average of readings, and assumed 12 hours per day in the bedroom, 5 hours in other areas of the house and 1 hour on the outside slab for 350 days per year.

Table 4 Stauffer Chemical Vicinity Properties - Residence 4

Location:	Residence 4	µrad/hr (waist level)
#1	garage	21.5
#2	garage	25.7
#3	garage	21.7
#4	garage	21.5
#5	foyer	10.2
#6	foyer	9.4
#7	foyer (by door)	13.0
#8	adjacent bath	12.1
#9	adjacent bath	9.8
#10	back door	11.4
Annual Dose	from building materials	50 (mrem)

Note: One thousand microrad (µrad) are equivalent to one millirem (mrem) for gamma radiation.. To calculate an Annual Dose, subtracted local background of 6 µrad/hr, then for each area (e.g. garage, foyer) took an average of readings, and assumed 12 hours per day in the house and 5 hours in the garage for 350 days per year.

Table 5 Maximum Contaminant Concentrations in Parts per Million (ppm)

Contaminant	Driveway Pavement	Driveway Base	Yard Soil	Comparison Value
Antimony	0.0566	0.252	0.0469	20 (Chronic RMEGs Child)
Arsenic	4.85	3.84	0.829	20 (Chronic RMEGS Child)
Beryllium	1.24	1.92	0.749	100 (Chronic RMEGS Child)
Chromium	27.7	22.3	49.6	200 (Chronic RMEGS Child)
Lead	18.2	11.7	31.8	400 (EPA Screening Level)
Thallium	0.70	0.614	0.0658	5 (Chronic RMEGS Child)
Vanadium	33.9	26.3	17.2	200 (Intermediate EMEG Child)
Radium-226	70.2 (pCi/g)	6.21 (pCi/g)	25.1 (pCi/g)	5 pCi/g to 5 cm depth 15 pCi/g below 5 cm (40 CFR 192)

Key: Reference Media Exposure Guideline (RMEGS)
Environmental Media Exposure Guideline (EMEG)
EPA Standards for Uranium and Thorium Mill Tailings {40 CFR 192 (1983)}
Code of Federal Regulations (CFR)

Appendix B Public Comments

The ATSDR responses to the following comments are in *italics*.

The ATSDR should be commended on this report since it conveys the radiological situation in Tarpon Springs to the public in a manner that is easy to understand. In addition, the radiation doses are put into proper perspective by comparison with the LOAEL and natural background. They should also be commended for their use of the word "guidelines" instead of "standards" when referencing the 100 mrem per year recommended dose limit. However, the report requires clarification on a number of issues.

The ATSDR should clarify that these guidelines do not apply to slag but are used to put the estimated doses into perspective. Phosphate slag is not a man-made radioactive material or a licensed radioactive material. It is a naturally-occurring radioactive material. It is appropriate to use these guidelines as a means of putting these estimated doses into perspective; however, the report fails to clarify this point.

Clarified throughout document that phosphate slag is a naturally occurring material.

As an example, the reports states that at one residence, the levels of ionizing radiation exceed both national and international guidelines for exposure by more than a factor of two. The report should indicate that these guidelines do not apply to phosphate slag, but only to licensed radioactive materials. The only guideline which could apply to phosphate slag is 500 mrem per year as recommended by the NCRP for continuous exposure to natural sources in remediation situations. In reference 6 (ICRP 60), the International Commission on Radiological Protection specifically states on page 44 that situations such that in Tarpon Springs are outside the scope of the dose limits for public exposure. Similarly, in reference 8 (NCRP 116), the National Council on Radiation Protection and Measurements states on page 45 that their recommended public dose limit of 100 mrem per year applies only to man-made sources of radioactivity. The radioactive material in phosphate slag is not man-made but naturally-occurring radioactivity. Yet, on page 7 of the ATSDR report, the reader is left with the impression that this guideline applies to exposures from phosphate slag. While the 100 mrem per year criterion is useful for comparison purposes, the public deserves to know that this criterion does not apply to radiation exposures from phosphate slag.

Corrected to make clear that the guideline for naturally occurring radioactive material in building materials comes from NCRP 116 and that this is not a man made radioactive material.

The report uses units of µrads, millirems, millrads, rems and rads. I would suggest that all the units be converted to millrems for clarity and ease of understanding. The reader is much more likely to understand a comparison between 300 mrem per year and 10,000 mrem than the comparison in Conclusion 3 between 300 mrem per year and 10 rem; and the comparison on page 7 between 100 millirem per year over a lifetime and 10 to 25 rem in one exposure. On page 7, for example, wording such as "The lowest observed adverse effect level from ionizing radiation is from 10,000 to 25,000 mrem in one exposure..." would be more understandable and provide a more useful perspective for the reader. The ATSDR should also be commended for the use of the LOAEL, since the public deserves to know that adverse health effects are not observed at dose levels such as those which are estimated in this report. The ATSDR should also list the occupational dose limit of 5,000 mrem per year as a level considered safe for occupational radiation workers.

Converted all units discussed to millirem.

The report indicates that the PIC is calibrated in µrad per hour. It is my understanding that a PIC is designed to measure gamma radiation in air, which is properly measured with the unit Roentgens per hour or micro-Roentgens per hour. The rad describes the absorption of energy in tissue, not air, although the conversion from Roentgens to rads is simple. I do not, however, recommend the use of this unit since all the units in the report should be converted, as accurately as possible, to millirem to avoid confusion. However, my understanding of the definition of the Roentgen indicates that the statement of calibration of the PIC may be incorrect.

The PIC is calibrated using a NIST traceable standard, so that readings can be converted to µrad per hour. The chamber is constructed from a tissue equivalent material, so that readings are tissue equivalent and energy independent.

On page 7, the report refers to "high" concentrations of radium-226 in phosphate slag. From a radiation protection standpoint, the concentrations of radium-226 found in phosphate slag cannot be considered high since concentrations of radium-226 can be found in the natural environment which exceed these levels. A more appropriate characterization would be "elevated" such as was appropriately used at the top of page 8 and in other parts of the report.

Changed to "elevated", as suggested.

This report goes to great lengths to educate the public as to the potential radiation doses which might be received by persons who may be exposed to phosphate slag in their homes and in the environment. The ATSDR's use of the LOAEL provides a comparison which is easy to understand if it is listed in the same units. However, the ATSDR should inform the reader as to the proper use of the radiation protection guidelines which are referenced in the report.

Attempted to clarify the proper use of ICRP and NCRP guidelines.

Radioactive materials off-site appear similar to radioactive materials on the SMC site. The slag, regardless of where it occurs, has a low-- but elevated-- level of radioactivity. Simply put, the degree of danger from any radioactivity is directly proportional to the amount of slag nearby.

Slag contains naturally occurring radioactive materials, which is considered part of background. Doses did not exceed any applicable guideline.

Prior to these studies, it was thought there might be "hot spots" from particularly radioactive batches of slag. This would be difficult to determine on-site due to the enormous amounts of slag. However, off-site it could manifest as unusually radioactive driveways or foundations. Fortunately, these studies show this is not the case.

No change necessary.

Since there is a proportional relationship between the amount of slag and radioactivity, the site itself represents the largest hazard to the community; however, some areas where large amounts of slag were incorporated into building foundations can represent a lesser threat. In particular, the residence constructed using "hurricane-proof" methods that incorporated slag into walls and sub-floors represents an obvious potential hazard to its occupants. There is too little data and far too much speculation on health effects in the PHA to support the conclusion that this residence is completely safe from slag radioactivity. Extrapolating from bomb data on the one hand, versus speculating on granite buildings on the other hand, is poor science.

A conservative dose estimate for a maximally exposed child residing in residence #1, was less than half the remediation guideline of the NCRP (8).

A study has been proposed for some time that would give residents radioactivity-sensitive film badges to accurately gauge individual exposure. This type of study affords another opportunity to view actual exposure, and such studies have been performed in other communities where there is a question of exposure. This data is needed before the full conclusions of the PHA can be accepted.

Film badges would not be sensitive enough and tend to fade. The ATSDR would recommend that any homeowner interested in measuring their individual dose obtain a Thermo-Luminescent Dosimeter (TLD) from a local accredited lab.

Conclusions in the PHA addendum regarding off-site arsenic cannot yet be accepted at face value. First, the report concludes arsenic is entirely trapped in vitreous "glass-like" material and therefore biologically unavailable. The studies authors seem to have jumped to this conclusion based on very little real data; to date the EPA has not provided compelling studies proving the "trapped arsenic" hypothesis. Secondly, the levels of arsenic considered toxic seem to be in debate. As far as can be determined, the ATSDR is deferring to the EPA, which is deferring to the State of Florida, which seems to be unable to offer any rationale for an arsenic threshold. Based on the discussions related so far it is doubtful if the state has a true policy regarding arsenic, and unlikely that any policy uses residential rather than commercial exposure level scenarios. Part of the picture is certainly political. According to a literature survey, arsenic has been a byproduct of numerous mining and manufacturing processes in Florida, as well as widely utilized in environmental control processes at golf courses and military institutions. Clearly, the State may not want to set a precedent for residential arsenic cleanup. Partly, the confusion over arsenic relates to its many different forms in the environment. As an element, arsenic will never be broken down, but arsenic can exist as soluble salts that are more toxic that the sintered form thought to occur in local Tarpon Springs residential areas.

EPA's samples of off-site slag were below health comparison values for arsenic.

There are soil extraction and toxicity tests that can answer some of the questions surrounding the safety of off-site materials. These studies could be designed to provide the toxicity answers thereby reducing community concerns. At the public meeting presenting the off-site findings, the EPA suggested that slag in the community be locally remediated as solid waste. This is also a logical opportunity to cancel the threat, or perceived threat, to local residents.

The ATSDR does not feel further sampling is warranted, based on current sample results.

The most obvious shortcoming, of this health assessment is that the findings on which it is based are incomplete and standards are either absent, presented without explanation (Table 5), ignored or dismissed.

There are not always good or consistent guidelines available to make public health evaluations. The ATSDR strives to make public health evaluations of completed or potential exposures. If there is no exposure possible, then there is no health risk.

Mathematical projections of radiation exposure have been made, which may or may not approximate the actual exposure of affected individuals. This would be acceptable if there were no alternative way to collect experiential data. This is not the case, however. A sampling of affected residents needs to be given radioactivity-sensitive film badges to wear (over a period of time to be determined by the scientific community) to more accurately measure individual exposures. The local citizens deserve to be advised on the basis of information about what exposure is actually happening, rather than OD projections that do not take into consideration the life style of the individuals involved. Since techniques do exist to monitor the actual accumulation of exposure to radioactivity, and since the costs associated with that technique are not outrageously high, it seems to us that prudence would dictate that any scientist - and we assume that these results are being analyzed by scientists, not actuaries or risk managers- would not only recommend but urge that this extra step be taken to measure the actual, not the projected, exposure of the affected citizens.

Film badges would not be sensitive enough and tend to fade. The ATSDR would recommend that any homeowner interested in measuring their individual dose obtain a Thermo-Luminescent Dosimeter (TLD) from a local accredited lab.

The solubility, and thus the toxicity levels, of arsenic in offsite materials have not been investigated. The theory that arsenic is trapped and chemically/biologically unavailable is unsubstantiated. There have been no specific studies indicating that this is the case in any or all contaminated areas being included in these generalized conclusions. Pursuant to this lack of convincing data of the solubility of arsenic and other chemical contaminants, the questions relating to potential groundwater contamination have gone unasked and unanswered. Wells located in any areas with significant slag need to be tested for the contaminants of concern. The question of contaminated groundwater below contaminated offsite areas has been ignored.

EPA samples were leach tested for heavy metals including arsenic and the lack of measurable quantities of arsenic and other heavy metals in leachate demonstrate that the material is insoluble and therefore not bioavailable.

There appears to be no agreement on what standards for arsenic are acceptable. While local citizens were once led to believe that 10^{-6} risk levels for arsenic were to be applied as clean-up levels (.4 ppm or .8 ppm, depending on whether federal or state guidelines are referenced), this no longer seems to be the case. The PHA Draft itself makes no mention of the current disagreement over standards, and instead lists an RMEGS Comparison Value of 20, which has the affect of minimizing the high arsenic concentrations found, leading to the average reader's perception that the arsenic level is substantially below "standards." While the lack of clarity and the misleading nature of the information in Table 5 could be construed as an attempt to confuse local citizens concerning the degree of contamination found in the study, we must assume that there was no ill intent. We believe the problem is one of inattention to communication skills. Specifically, there is no definition and clarification of the actual meaning of the information in the "Comparison Value" column. The brief reference to this term on page 8 is not particularly enlightening or reassuring. In addition there is no information concerning the "commercial" and "residential" standards for the various heavy metal contaminants. We recognize that there is disagreement between the EPA and FDEP concerning certain standards and feel that this is of such importance that comment on the issue should have appeared in this report.

It is true to say that there is considerable disagreement on a standard for arsenic in various media. Because the ATSDR is not a regulatory body, we use media specific guidance from our staff of board certified toxicologists.

The Public Health Implications (page 8) contain a number of confusing and inconsistent statements. While acknowledging that both the ICRP and the NCRP recommend limiting annual exposure to external radiation to 100 mrem/yr above background levels, and that the annual dose to a person living in Residence #1 could be over twice that limit, it goes on to predict that no adverse health effects would be expected from residing in that home. Within the space of the paragraphs, standards are described, a case in which the contamination considerably exceeds those standards is cited, and then the statement is made that no ill effects are anticipated. It is also stated on page 8 that contaminated slag does not appear to contain sufficient heavy metals to represent a public health hazard, ignoring the fact that levels of arsenic are well over the State of Florida's acceptable levels. Thus, there appears to be an arbitrary use of standards in this document. They are invoked when convenient. and at ether times ignored. The PHA lists standards for radiation and arsenic in some areas of the text, and then proceeds to ignore them in the Conclusion.

The 100 mrem/yr standard is mentioned only for comparison, as the source of radiation is from naturally occurring radioactive materials. Naturally occurring radioactive materials are considered part of background, and the 100 mrem/yr standard is to protect from man-made exposures. The NCRP (8) has recommended remediation only if the annual dose from naturally occurring radioactive material in building materials exceed 500 mrem/year.

How is the ATSDR able to legitimately state that no ill effects are expected when standards are violated? It appears that the ATSDR chooses which standards to ignore and then does not give any rationale for so doing. The words "arbitrary" and "capricious" are used in the legal and community to describe this lack of consistency in applying applicable rules and standards.

No health guidelines have been exceeded.

This report has done very little to allay the fears of concerned residents, or to convince them that they are being protected.

The ATSDR has taken the following steps to explain that there is no public health threat from the limited use of phosphate slag in buildings and roads:

a. *Met with individual homeowners on numerous occasions,*
b. *Held public meetings and availability sessions,*
c. *Coordinated with the EPA and the State of Florida Department of Health,*
d. *Responded to numerous letters and phone calls from the press, the public and elected officials,*
e. *Preparing public health education in conjunction with the State of Florida Department of Health.*