

Health Consultation

Evaluating Dose Measurements of Gamma Radiation
for Residents near the Stauffer Chemical Company

STAUFFER CHEMICAL COMPANY SUPERFUND SITE AND
VICINITY PROPERTIES
[a/k/a STAUFFER CHEMICAL COMPANY (TARPON SPRINGS)]

TARPON SPRINGS, PINELLAS COUNTY, FLORIDA

EPA FACILITY ID: FLD010596013

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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
Atlanta, Georgia 30333

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Prepared by:

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

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, phosphorus slag was transported off the site and used as aggregate in road bedding, road and driveway paving, and in concrete structures. Residents in the area are concerned about possible adverse health effects resulting from exposure to gamma radiation from phosphorus slag that was used in nearby roads, buildings, and homes. Gamma radiation, or gamma rays, consists of bundles of electromagnetic energy and is the same type of radiation as medical x-rays.

In 1999, at their request, residents of the community surrounding the former Stauffer chemical plant were given thermoluminescent dosimeters (TLDs) by the Pinellas County Health Department to monitor their individual gamma radiation dose measurements for a 30-day period. As a follow-up to the previous public health assessment addendum for the site issued in June 1999 and to a draft public health response plan for the site released in June 2001, the Agency for Toxic Substances and Disease Registry (ATSDR) reviewed the individual dose measurements recorded by the Pinellas County Health Department for the 60 participants of this Tarpon Springs, Florida, community.

The exposure investigation was field research of a descriptive nature and was not designed or conducted as an inferential investigation. No generalizations should be drawn from it. The sample consisted of individuals from southwest Pasco County and northern Pinellas County and contained every person who volunteered. Originally, it was anticipated that there would be a large number of volunteers and that a sample of those volunteers would be chosen to wear the dosimeter badges. Because there were only as many volunteers as there were badges, the entire sample was self-selected.

Background, or naturally occurring radiation, varies by location in the United States and is measured in one-thousandth of rem, or millirem (mrem). Background radiation comes from cosmic sources, naturally occurring radioactive materials (e.g., radium in phosphate ore), the food and water we consume and global fallout as it exists in the environment from nuclear weapons testing. Background gamma radiation dose rates for the United States average anywhere from 44 to 133 mrem per year. The average dose to 57 of the 60 monitored in Pinellas and Pasco counties was 92 mrem per year, although it was not possible to quantify the contribution from slag for all participants.

Two participants lost their dosimeters and were therefore not included. One participant had an elevated dose of 166 mrem per year, and on a follow-up measurement by ATSDR, was found to have an area of pure phosphorus slag poured on the soil foundation under her home. The dose of 166 mrem per year was confirmed and elevated, but does not represent any health threat to the resident.

Another participant had a single monthly dose of 41.1 mrem, which would equate to a dose rate of 529 mrem per year. ATSDR made follow-up measurements of the participant's home, yard and office, and was unable to locate the source of the elevated exposure. This participant's dose

was excluded from the calculation of the average, median and standard deviation, because ATSDR could not confirm the source of the dose with environmental monitoring. Though the measured exposure could not be confirmed by environmental measurements, ATSDR used the high level to estimate the annual rate, which was determined not to be a health threat.

The measurements of the remaining 57 participants show that the combined gamma radiation doses measured by TLDs are not elevated and do not pose a health threat to participants.

Background and Statement of Issues

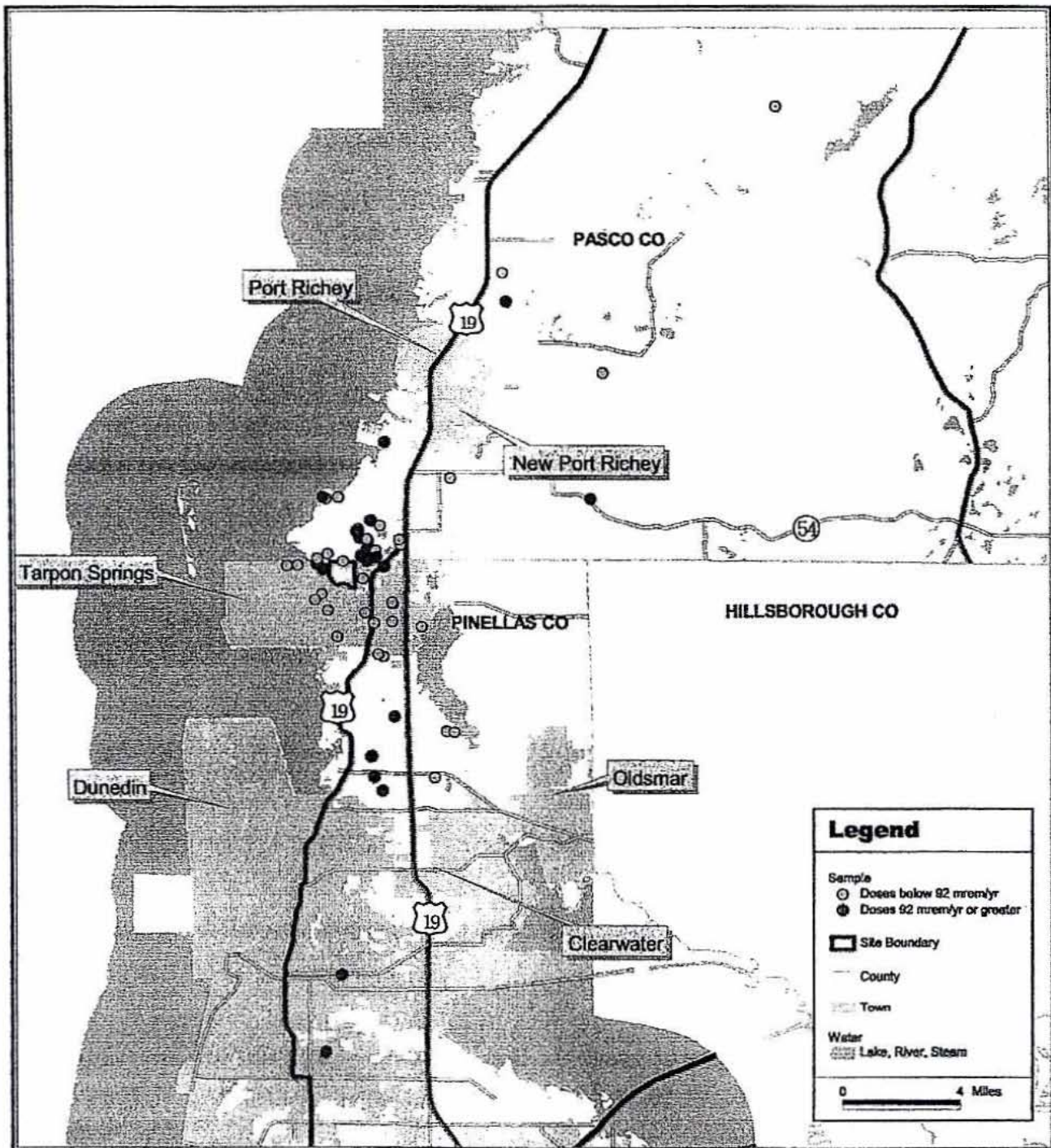
The Pinellas County Health Department, responding to public request, provided thermoluminescent dosimeters (TLDs) to persons who wanted their radiation dose measured and who lived near the former Stauffer chemical plant in Tarpon Springs, Florida. The Agency for Toxic Substances and Disease Registry (ATSDR) evaluated the gamma radiation doses measured by the Pinellas County Health Department for residents near the site who had requested TLDs. This ATSDR evaluation is a follow-up action to the previous Public Health Assessment Addendum¹ on phosphorus slag for the Stauffer Chemical Company site and Vicinity Properties in Tarpon Springs and Holiday, Florida, which was issued in June 1999, and to a draft public health response plan for the site released in 2001.

ATSDR has previously reviewed sampling and survey data collected by the Florida Department of Public Health² and the Environmental Protection Agency Region IV³, as well as the previous public health assessment that was performed by the Florida Department of Public Health under a cooperative agreement with ATSDR⁴.

The exposure investigation was field research of a descriptive nature and was not designed or conducted as an inferential investigation. No generalizations should be drawn from it. The sample consisted of individuals from southwest Pasco County and northern Pinellas County and contained every person who volunteered. Originally, it was anticipated that there would be a large number of volunteers and that a sample of those volunteers would be chosen to wear the dosimeter badges. Because there were only as many volunteers as there were badges, the entire sample was self-selected. In addition there are several studies that have looked at radiation from the phosphorus slag from the Stauffer site. The ATSDR Public Health Assessment Addendum¹ on phosphorus slag is heavily based on the January 1999 EPA report. This evaluation only looks at radiation doses measured by the Pinellas County Health Department, measured in late Fall 1999.

TLDs are made of crystalline material (solid state) that emits light in proportion to the ionizing radiation absorbed, when the device is heated.

Dose measurements performed at the residents' request were purely voluntary. TLDs were distributed to residents of the communities surrounding the former plant, regardless of whether they had phosphorus slag on their property. The Vicinity Map shows the locations of the study participants. These residents were asked to wear the TLDs all day for a 30-day period, but not during medical procedures (e.g., x-rays) or expose them to known radioactive sources. ATSDR assumed that the participants were compliant with given instructions. Measurements were extrapolated, or projected, to yearly doses. The measurements were taken during the last few months of 1999⁵. For the purpose of this consultation, ATSDR will assume that all homes potentially contained some slag, because the use of phosphorus slag and phosphorus ore as aggregate is widespread in this part of Florida, and most people are, to some degree, exposed to gamma radiation from the slag or ore. A table of measured doses for this exposure assessment is located at the end of this consultation.



Participant locations for Pinellas/Pasco TLD assessment

VICINITY MAP



Discussion

The average dose rate to 57 of the 60 participants was 92 mrem per year. Two participants (#40 & #50) lost their badges and therefore did not receive a dose measurement. Participant #38 had a 30 day dose of 44.1 mrem, which equates to an annual dose rate of 529 mrem per year. ATSDR made follow-up measurements of the participant's home, yard and office, and was unable to locate the source of the elevated exposure⁶.

Participant #38's dose was also excluded from the calculation of the average, median and standard deviation. The elevated exposure could have been the result of visiting a patient at a medical establishment where nuclear medical treatment and diagnostic procedures are performed, visiting someone who had a nuclear medical procedure (e.g., I-131 thyroid ablation, thallium stress test, bone scan, etc.) or from having a diagnostic nuclear medical procedure.

One additional subject (#49) included in the calculations, measured 166 mrem per year, which was well above the average for this assessment and above the range of average for the United States. Average background doses from terrestrial and cosmic gamma radiation for cities in the United States range from 44 to 133 mrem per year⁷ and for this exposure assessment was 92 mrem per year. The doses in cities have been measured with environmental TLDs for more than thirty years. The doses are reported as averages within a city and do not represent the range of doses within each city. Because, participant #49's dose was well above the typical background in the US and well above the average dose in the exposure investigation, ATSDR surveyed the home and found an area of pure slag poured over its soil foundation. (Note: Phosphorous slag is a basaltic byproduct material that was commonly crushed and used in Florida as concrete aggregate. Pure slag refers to the use of slag in its raw undiluted form.)

Survey measurements of subject #49's home were consistent with the measured dose. The survey instrument used was a Ludlum MicroR Meter Model 19, serial # 77635, calibrated on Oct. 3, 2001. The Patio where the participant spent more than 50% of her time, measured 44 μ R/hr at one meter. This would result in an annual dose rate of 150 mrem/yr, when corrected for radium. This is consistent with the TLD measured annual dose rate of 166 mrem/year which includes all sources including background.

Figure 2, shows the distribution of doses in the study versus the number of participants at that dose. The graph excludes those who lost their TLDs.

ATSDR's Minimum Risk Level⁸ (MRL) for ionizing radiation is 100 millirem per year above background. The MRL is an estimate of human exposure-by a specified route and length of time-to a dose of chemical or other agent that is likely to be without measurable risk of adverse, non-cancerous effects. An MRL should not be used as a predictor of adverse health effects. (Note: background includes the dose from building materials). To put this in perspective, normal background from terrestrial, cosmic and internal gamma emitters average 100 mrem/yr. A common chest x-ray will give an effective dose of 60 mrem in a fraction of a second. A full abdominal CT scan will give an effective dose of 1,000 mrem in several minutes. Neither of these diagnostic medical procedures is believed to cause adverse health effects⁹.

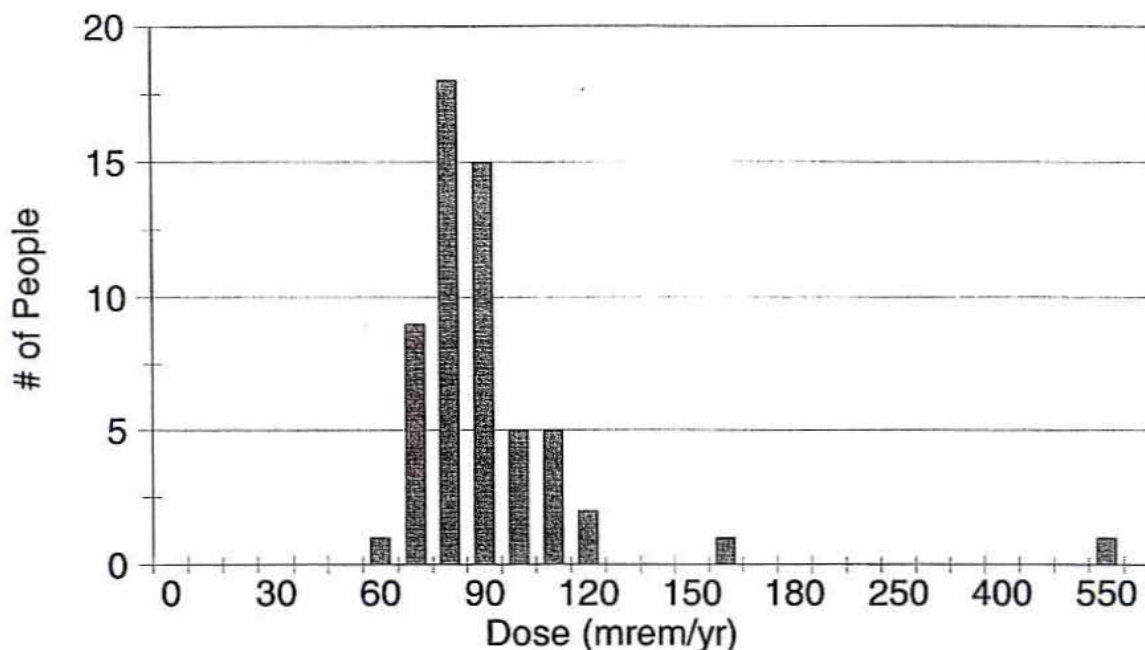


Figure 2 Annual Gamma Doses to Study Participants

The average annual effective dose in the United States population from natural background radiation is 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/yr¹⁰.

The Health Physics Society, the leading professional organization of radiation protection professionals, in its position statement "Radiation Risk In Perspective", states that "radiogenic health effects have not been observed below 10 rem" (10,000 mrem)¹¹. It goes on to say:

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

Conclusions

1. The combined gamma radiation doses, as measured by TLDs, for the participants near the former Stauffer chemical plant do not pose a health threat to the participants in this exposure assessment and are consistent with background, with one exception.(see conclusion #2)
2. The individual (#49) that received 166 mrem dose is outside the normal range of background for Tarpon Springs, Florida, although not of sufficient magnitude to warrant concern from a health standpoint.
3. Participant #38's dose measurement was not confirmed. ATSDR made follow-up measurements of the participant's home, yard and office, and was unable to locate the source of the elevated exposure. Even if this dose was received every month, it would not result in a threat to the individual's health.

Public Health Actions Taken

1. ATSDR performed a follow-up radiation survey at the location where the 166 mrem level was observed and found that it was due to pure phosphorus slag poured over a soil foundation underlying the porch and livingroom. If the current resident is concerned about their dose, they can minimize their time spent in the livingroom and on the porch, or have the slag removed from the foundation.
2. ASTDR also performed a follow-up survey at the home, yard and office of subject #38, and there were no elevated dose readings at any location.

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Health Physicist

Table 1. Measurement Data

Subject #	City	Zip Code	Gamma Dose (mrem/yr)
1	Palm Harbor	34684	82
2	Tarpon Springs	34689	78
3	New Port Ritchie	34655	95
4	Tarpon Springs	34689	84
5	Holiday	34691	88
6	Tarpon Springs	34689	86
7	Tarpon Springs	34689	90
8	Holiday	34691	100
9	Palm Harbor	34683	113
10	Holiday	34691	62
11	New Port Ritchie	34652	110
12	Tarpon Springs	34689	88
13	Tarpon Springs	34689	122
14	Tarpon Springs	34689	89
15	Tarpon Springs	34689	76
16	Holiday	34691	94
17	Holiday	34691	101
18	Holiday	34691	83
19	Holiday	34691	88
20	Holiday	34691	94
21	Palm Harbor	34684	88
22	Holiday	34691	102
23	Holiday	34691	91
24	Holiday	34691	84
25	Holiday	34691	90
26	Palm Harbor	34683	97
27	New Port Ritchie	34652	90
28	Tarpon Springs	34689	116
29	Holiday	34691	86
30	New Port Ritchie	34654	91
31	Holiday	34691	112
32	Port Ritchie	34668	82
33	Palm Harbor	34683	100
34	Holiday	34691	85
35	Holiday	34691	80
36	Holiday	34691	79
37	Clearwater	33755	95
38	Tarpon Springs	34689	529*
39	Holiday	34691	85
40	Tarpon Springs	34689	lost
41	Tarpon Springs	34689	79
42	Tarpon Springs	34689	90
43	Holiday	34691	103
44	Palm Harbor	34684	79
45	Holiday	34691	72
46	Holiday	34691	85
47	Holiday	34691	73
48	Holiday	34691	94
49	Tarpon Springs	34689	166
50	Tarpon Springs	34689	lost

Subject #	City	Zip Code	Gamma Dose (mrem/yr)
51	Holiday	34691	70
52	Tarpon Springs	34689	83
53	Shady Hills	34610	83
54	Tarpon Springs	34689	95
55	Tarpon Springs	34689	86
56	Holiday	34691	116
57	Tarpon Springs	34689	73
58	Palm Harbor	34683	120
59	Tarpon Springs	34689	91
60	Port Ritchie	34668	95
	Median		89
	Standard Deviation		16

* included in calculations, because #38 received non-environmental exposures

References

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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.
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