A Summary of the Fernald Risk Assessment Report, Centers for Disease Control and Prevention, National Center for Environmental Health, December 1998

ESTIMATION OF THE IMPACT OF THE FORMER FEED MATERIALS PRODUCTION CENTER (FMPC) ON LUNG CANCER MORTALITY IN THE SURROUNDING COMMUNITY

Draft risk estimates provided to the community in August 1996 from the Fernald Dosimetry Reconstruction Project (FDRP) did not provide a comprehensive summary of the potential health effects of the Fernald Feed Materials Production Center (FMPC) on residents in the surrounding community. Many individuals, who could not relate their own experiences to those defined in the nine exposure scenarios provided in the Fernald Dosimetry Reconstruction Project Report were left with questions about their risk. Because of this, CDC proposed to analyze human health risk for the community surrounding the FMPC using a model-based risk estimation. We determined that this approach would provide a summary estimate of the number of selected disease outcomes that could potentially occur due to exposure to radioactive materials released from the FMPC during its operating years (1951-1988). However, this approach only provides estimates of the FMPC-related risk at the community-level and it can not be used to estimate risk for specific individuals. The results from this type of risk assessment also allows us to determine the scientific feasibility of an epidemiologic study of selected disease outcomes.

The December 1998 Fernald Risk Assessment Report provides the results of the first phase of the Fernald Risk Assessment Project. Lung cancer is the most likely health outcome associated with radionuclides (primarily radon and uranium) released to the environment during FMPC operations from 1951 through 1988. The results outlined in the report include:

- Estimates of the number of lung cancer deaths occurring from 1951 through 2088, among those who resided near the site, that may be due to exposure to radioactive material released from the FMPC during its years of production (1951-1988); and

- Estimates of the percentage increase in the number of lung cancer deaths over the number that would be expected in the absence of these exposures.

Future reports will provide risk estimates for a broader range of additional health outcomes (such as kidney and bone cancer) that are perceived by the community to be related to past releases of radioactive materials from the FMPC and for which biologic and other scientific evidence indicate the potential for such a relationship.

Key Results

- **We estimate that approximately 40,000 to 53,000 individuals resided within the assessment domain, within 6.2 miles or 10 kilometers of the FMPC site, for some time during the years of FMPC operation, 1951-1988.**

- **Because we can not actually identify lung cancer deaths that are caused by FMPC exposure, the estimated number of FMPC-related lung cancer deaths is uncertain. While the median estimate is 85 lung cancer deaths, the actual number of FMPC-related lung cancer deaths may range from 25 to 309 deaths.**

- **We estimate the number of lung cancer deaths occurring between 1951 and 2088 may be increased by 1% to 12% as a result of FMPC-related radiation exposures.**

- **We estimate that the median lifetime lung dose for people who lived in the assessment domain during 1951 through 1988 was 0.45 sieverts. The 90% credibility interval for the estimated lifetime lung dose ranged from 0.12 sieverts to 1.74 sieverts. Most of this estimated dose occurred through breathing radon decay products.**

- **Our results indicate the estimated percentage increase in the number of FMPC-related lung cancer deaths that may have occurred before the year 2000 is about 3 times the value predicted in the later time period (2001-2088). This is because the study population is aging and their background rates of lung cancer mortality and mortality due to causes other than lung cancer are increasing as they age.**

- **We estimate a higher percentage increase in the number of lung cancer deaths due to FMPC-related exposure for areas to the east of the site as compared to areas west of the site and, within each geographic area, a higher percentage increase closer to the site as compared to distances farther away.**

- **The installation of containment measures to the K-65 silos in 1979 greatly reduced the amount of radon and radon decay products released from the site. We found that virtually all the estimated increase in lung cancer deaths occurred among those first exposed before 1980.**
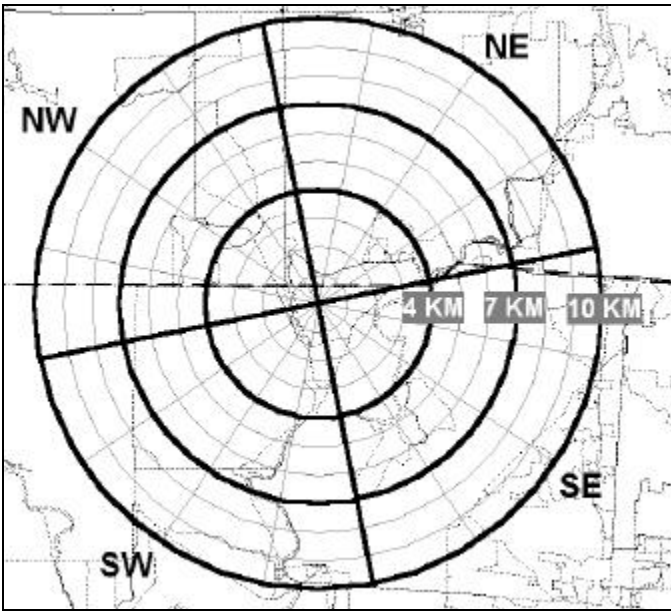
The Assessment Domain

This figure shows the geographic study area we used in the Fernald Risk Assessment Project. It captures what is termed as the "assessment population"— defined as people who resided within a radius of 10 kilometers (6.2 miles) of the center of the FMPC production area for some period of time between the years 1951-1988.

The area is subdivided into 12 smaller regions based on direction and distance from the site. These were used to summarize the results.

We estimate that 40,000 to 53,000 individuals resided in the assessment domain during the plant's operating years, 1951-1988.

Estimates of the number of lung cancer deaths presented in this report were made by estimating the radiation lung dose, the risk of lung cancer death resulting from that dose, and the number of people experiencing that risk at various points in time. Estimates for these components, dose, risk, and population size, were made using mathematical models. Because we are uncertain about the true values of these components, there is uncertainty about the true number of lung cancer deaths that may result from exposure to FMPC-related radioactive materials.

In the table at right, we summarize the results of our estimation using the median* number of lung cancer deaths occurring from 1951 through 2088. The number of lung cancer deaths that may be due to exposure to radioactive material released from the FMPC is about 85 deaths--with the 90% credibility interval** ranging from about 25 to 309 deaths.

The National Academy of Sciences estimates that the lung cancer mortality risk resulting from radon exposure is greater among ever smokers than never smokers. Because of this, we estimate about 3 times as many ever smokers than never smokers may die from FMPC-related lung cancer.

Because more men have ever smoked than women, the estimated number of FMPC-related lung cancer deaths among males is about 40% higher than the estimate for females.

ESTIMATED TOTAL LUNG CANCER DEATHS THAT MAY BE DUE TO FMPC-RELATED RADIATION EXPOSURES AND TOTAL BACKGROUND LUNG CANCER DEATHS FROM 1951 THROUGH 2088

	FMPC-Related Lung Cancer Deaths			Background Lung Cancer Deaths		
	Median *	90% Credibility Interval **		Median *	90% Credibility Interval **	
		(lower limit)	(upper limit)		(lower limit)	(upper limit)
Entire Population	85	25	309	2,601	2,257	3,014
Ever Smokers	65	19	238	2,302	1,997	2,666
Never Smokers	20	6	71	298	258	347
Males	49	14	187	1,692	1,496	1,978
Females	36	11	135	889	780	1,041

* The median is that value greater than one half of the estimates and less than the other half.

** The 90% credibility interval (sometimes called the uncertainty range) includes 90% of the possible FMPC-related lung cancer mortality estimates between its upper and lower limits.

The columns labeled "Background Lung Cancer Deaths" shows the estimated number of lung cancer deaths predicted to occur in the population of the assessment domain if there were no releases of radioactive materials from the FMPC.

MEDIAN VALUE FOR THE ESTIMATED TOTAL NUMBER OF LUNG CANCER DEATHS PREDICTED TO OCCUR AMONG THE ASSESSMENT DOMAIN POPULATION
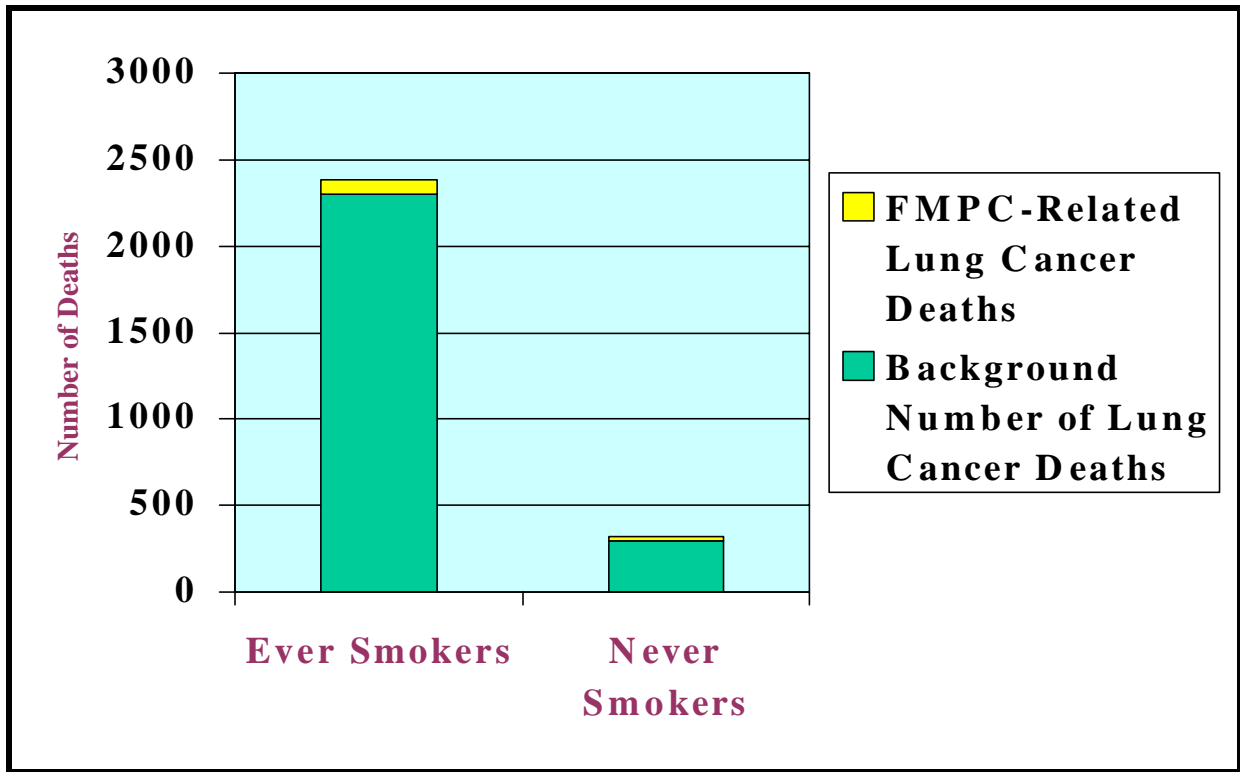
This table shows that exposure to radioactive material released from the site during its years of operation may result in about a 3% increase in the number of lung cancer deaths among residents of the assessment domain over the number of lung cancer deaths that may occur in the absence of these exposures (90% credibility interval of 1% to 12%).

Because background lung cancer mortality is quite low for never-smokers, the estimated percentage increase in lung cancer deaths that may result from FMPC-exposure is approximately 2 times greater among never smokers than among ever smokers.

The percentage increase for males and females is similar.

ESTIMATED PERCENTAGE INCREASE (%) IN THE NUMBER OF LUNG CANCER DEATHS FROM 1951 THROUGH 2088 THAT MAY BE DUE TO FMPC-RELATED RADIATION EXPOSURES

	Median	90% Credibility Interval	
		(lower limit)	(upper limit)
Entire Population	3 %	1 %	12 %
Ever Smokers	3 %	1 %	10 %
Never Smokers	7 %	2 %	24 %
Males	3 %	1 %	10 %
Females	3 %	1 %	12 %

Definition:

Percentage Increase =

$$\frac{\text{Number of FMPC-Related Lung Cancers}}{\text{Number of Background Lung Cancers}} \times 100$$

TOTAL NUMBER OF LUNG CANCER DEATHS THAT MAY BE DUE TO FMPC-RELATED RADIATION EXPOSURES AND BACKGROUND LUNG CANCER DEATHS, BY TIME PERIOD

Time Period	FMPC-Related Lung Cancer Deaths			Background Lung Cancer Deaths		
	Median	90% Credibility Interval (lower limit) (upper limit)		Median	90% Credibility Interval (lower limit) (upper limit)	
1951-2000	45	14	165	748	653	869
2001-2088	39	11	150	1,848	1,588	2,157

This table separates the estimated number of lung cancer deaths into 2 time periods. The first time period corresponds to years from the first year of potential exposure (1951) to the year 2000. The second time period projects through to 2088 allowing the group of people potentially exposed during the last year of plant operations (1988) the opportunity to reach an age of 100 years.

We estimate that approximately half of the total number of lung cancer deaths that may be related to FMPC radiation exposures will have occurred by the year 2000.

PERCENTAGE INCREASE (%) IN LUNG CANCER DEATHS THAT MAY BE DUE TO FMPC-RELATED RADIATION EXPOSURES, BY TIME PERIOD

Time Period	Median	90% Credibility Interval (lower limit)	(upper limit)
1951-2000	6 %	2 %	22 %
2001-2088	2 %	1 %	8 %

Our results indicate the estimated percentage increase in the number of FMPC-related lung cancer deaths that may have occurred before the year 2000 is about 3 times the value predicted in the later time period (2001-2088).
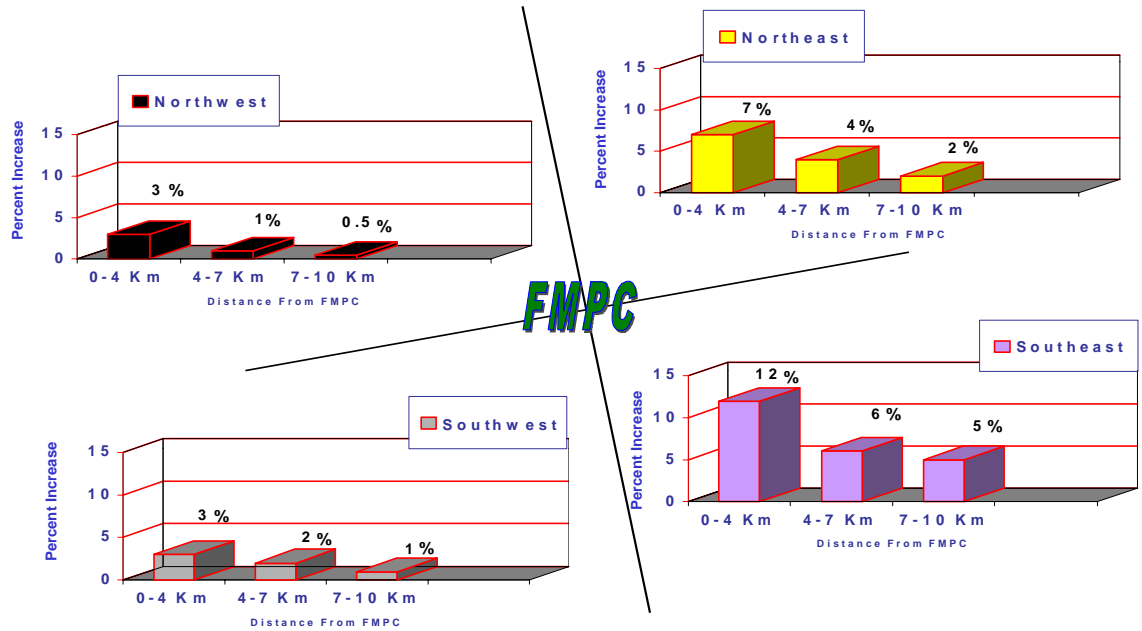
This is because the study population is aging and their background rates of lung cancer mortality and mortality due to other causes are increasing as they age.

IMPORTANT NOTE: The numbers presented in these figures, tables and summary text are not exact estimates. We cannot prove that FMPC-related exposures caused or will cause lung cancer deaths in either the community or specific individuals. Our work is a prediction of the *chance* of such an effect.

ESTIMATED PERCENTAGE INCREASE IN THE NUMBER OF LUNG CANCER DEATHS FROM 1951 THROUGH 2088 THAT MAY BE DUE TO FMPC-RELATED RADIATION EXPOSURES, BY GEOGRAPHIC AREA

In this figure, we show the median value of the estimated percentage increase in the number of lung cancer deaths that may result from past exposure to radioactive material released from the FMPC.

We estimate a higher percentage increase in areas to the east of the site as compared to areas west of the site and a higher percentage increase for areas close to the site as compared to those farther away.

Northwest

Percent Increase

3 %   1%   0.5 %

0-4 Km   4-7 Km   7-10 Km

Distance From FMPC

Northeast

Percent Increase

7 %   4 %   2 %

0-4 Km   4-7 Km   7-10 Km

Distance From FMPC

FMPC

Southwest

Percent Increase

3 %   2 %   1 %

0-4 Km   4-7 Km   7-10 Km

Distance From FMPC

Southeast

Percent Increase

12 %   6 %   5 %

0-4 Km   4-7 Km   7-10 Km

Distance From FMPC

Because of the small number of residents that were estimated to have lived in some areas of the assessment domain during 1951-1988, these percentage increase estimates must be interpreted cautiously. Small populations increase the uncertainty in the estimates of percentage increase in lung cancer deaths that may be due to FMPC-related exposure.

Containment measures applied to the K-65 silos in 1979 greatly reduced the amount of radon and radon decay products released from the site. Because exposure to radon and radon decay products was the major contributor to the estimated lung dose, those who were born, or who first moved into the assessment domain, after 1979 will have a lower FMPC-related lung dose than those who were first exposed earlier.

The table below shows the estimated percentage increase in lung cancer deaths that may result from FMPC-related radiation exposures among the population first exposed any time from 1951 through 1979 and those first exposed between 1980 and 1988. Our results indicate that FMPC-related radiation exposure has very little impact on the estimated risk of lung cancer death among those who were born, or who first moved in to the area, after 1979.

PERCENTAGE INCREASE IN LUNG CANCER DEATHS THAT MAY BE DUE TO FMPC EXPOSURES, BY YEAR OF FIRST EXPOSURE

Year of First Exposure	Median * #	90% Credibility Interval **	
		(lower limit)	(upper limit)
1951 - 1979	5 %	1 %	18 %
1980 - 1988	0.1 %	0 %	1 %

Key Points

- Risk estimation is not an exact science.

- We did not collect data from community members; therefore, we had to make assumptions regarding such things as exposure history, lifestyle factors that may have affected dose, and smoking history.

- We cannot predict risk for individuals, only populations.

- We used mathematical models to estimate population size, dose and risk.

- We had to assume that risk models developed from experiences of underground miners of uranium and other minerals and atomic bomb survivors are applicable in the Fernald population.

- This risk assessment includes only exposures resulting from releases of radioactive materials from the FMPC during its years of operation, 1951-1988.

- This risk assessment includes only exposures to residents in the surrounding community (within a 6.2 mile radius from the center of the site). No exposures incurred as a result of working at the FMPC are included.

- This risk assessment includes exposures resulting from inhalation, ingestion and direct external exposures to radon, uranium and thorium isotopes and their decay products, and other radionuclide releases from the FMPC from 1951 through 1988.

- Because components of this risk assessment process are uncertain, the resulting estimates of FMPC-related lung cancer deaths and the percentage increase in deaths are also uncertain.

Public Health Recommendation

There is currently no way to reduce the exposures from the FMPC site that occurred in this population between 1951 and 1988. However, the CDC recommends actions that citizens can take now to lower their risk of lung cancer. First, if they smoke they should quit, and second, they should test their homes for naturally occurring radon. If the radon concentration in their home from natural sources exceeds the U.S. Environmental Protection Agency's recommended limit, then they should act to lower these levels. Information on reducing the level of naturally occurring radon in your home can be obtained by calling the Ohio Environmental Protection Agency's Ohio Radon Information line at (800) 523-4439 or by calling the Ohio Department of Health at (614) 466-0061.

Who to Contact for More Information

Public involvement is critical to this project and all CDC's health effect work in the community surrounding the FMPC. We encourage your input and attendance at the quarterly meetings of the Fernald Health Effects Subcommittee, public meetings and through telephone calls. All public meetings are held in the local area near the FMPC site and are announced through public notices in two local newspapers (the Hamilton-Journal News and the Harrison Press), in the community calendar in the Cincinnati Enquirer and through CDC's Fernald mailing list (to get on the mailing list, contact the address and/or phone numbers below).

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