Fermi3CEm Resource

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Subject: Fermi Comments by Joe Mangono to DEIS: Docket ID NRC-2008-0566
Attachments: Fermi report, Jan. 2012.doc

Docket ID NRC-2008-0566
Draft Environmental Impact
Statement for Combined License (COL)
for Enrico Fermi Unit 3
report number: NUREG-2105

Please find attached document entitled labeled Fermi report Jan. 2012 - The document includes:

POTENTIAL HEALTH RISKS POSED BY ADDING A NEW REACTOR AT THE FERMI PLANT

Radioactive contamination from Fermi 2 and changes in local health status

by

Joseph J. Mangano, MPH MBA
Executive Director
Radiation and Public Health Project
January 10, 2012

These are being submitted by Michael J. Keegan of Don't Waste Michigan.
The attached comments are however the Health Report of Joseph J. Mangano.

Additional Comments by Michael J. Keegan in support of the attached Health Report by Joseph J. Mangano

Below is the table of contents on the DEIS for Radiological Impacts. It is precisely because the operation of a nuclear power plant allows for the routine effluents of gaseous, liquid and solid radionuclides below 'permissible allowable levels' and during routine operation, and during accidental discharges, that Independent Monitoring is needed. Part of that Independent Monitoring is a Community Baseline Health Study and that is what I am requesting at this time.

The DEIS and the Environmental Report have omitted a great deal in the consideration of Water Intake and Safe Drinking Water. What has been provided is a tertiary overview which does not address the gravity of the situation.
In order to protect public health, I am requesting that a Community Baseline Health Study established. This must be done in a transparent and sound methodological approach.

Thank you
Michael J. Keegan
Don't Waste Michigan
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Federal Register Notice: 76FR66998
Comment Number: 49

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EXECUTIVE SUMMARY

In November 2008, Detroit Edison submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a new nuclear reactor (Fermi 3) in southeast Michigan. In October 2011, an Environmental Impact Statement (EIS) was released for public comment, and the following report addresses issues of environmental impact.

Even though it mandates a lengthy process before deciding on whether to grant a license to the proposed new reactor, the NRC has no provision mandating that the utility produce evidence demonstrating the safety of the new unit. Neither was addressed in the EIS, other than to conclude (without empirical evidence) that the potential for meltdown would be extremely small, and that routine radioactive releases into the environment would not harm local residents. This report provides a basic "report card" of operations at Fermi 2 as a means to help evaluate safety and health issues posed by Fermi 3.

Contamination from Fermi 2 – both potential and actual – are multiple and concerning. The chance of a meltdown at a nuclear reactor is all too real. Prior meltdowns from human error at places like Three Mile Island and Chernobyl have been augmented by the 9/11 attacks in 2001, which created a real threat of a meltdown from acts of sabotage, and by the 2011 earthquake and tsunami in Japan, which caused meltdowns at four reactors at the Fukushima plant. Fermi 2 has had several events that raised the possibility of a meltdown in the past decade. With a population of 4.8 million living within 50 miles of the plant, a meltdown would be catastrophic for the Detroit area, along with parts of Ohio and Canada.

Like all reactors, Fermi 2 has routinely emitted radiation into the local air since it began operating at low power in June 1985 and full power in January 1988. NRC data suggest that emission levels have been higher at Fermi than for most U.S. reactors.

Analyses were conducted on changes in the Monroe County (vs. the U.S. or Michigan) rates of diseases and deaths known to be especially susceptible to radiation exposure since the 1980s (before and just after Fermi 2 startup). Of 19 indicators, the Monroe County rate change exceeded the state or nation for all 19, with 10 of them statistically significant and 4 others approaching significance. These indicators included:

- Infant deaths
- Low weight births
- Cancer mortality for all ages, plus children, young adults, and the very elderly
- Cancer incidence for all cancers, plus breast, colorectal, lung, and prostate
- Mortality for all causes other than cancer
- Hospitalization rates for all causes, cancer, and birth defects

More analysis is merited here, but these strongly consistent findings should be taken seriously. This report concludes that no decision should be made on whether or not to approve a license for Fermi 3 until more research of this type is undertaken; a thorough public education and discussion process occurs; and that the majority of local people still approve of the new reactor with this additional knowledge.

INTRODUCTION

The Fermi nuclear plant is located on Lake Erie, in Monroe County Michigan, about 26 miles south of Detroit. The table below shows Fermi has been the site of two operating nuclear reactors; Fermi 1 closed in 1972, while Fermi 2 is still in operation. A new Fermi 3 reactor was ordered in 1972, but cancelled two years later (Table 1). The current proposed Fermi 3 is a different project and design than the 1972 proposal.

Table 1
Reactors Ordered at the Fermi Nuclear Plant

Reactor	Megawatts	Application	Went Critical	Closed
Fermi 1	61	6/ 1/56	8/23/63	9/22/72
Fermi 2	1065	7/26/68	6/21/85	
Fermi 3	1171	1/ 1/72	Never Built	

Source: U.S. Nuclear Regulatory Commission, www.nrc.gov

In November 2008, Detroit Edison Company proposed building a new Fermi 3 Economic Simplified Boiling Water Reactor of 1560 megawatts electrical/4680 megawatts thermal at the site, and is seeking a "Combined Operating License" from the U.S. Nuclear Regulatory Commission (NRC). The NRC prepared a draft Environmental Impact Statement (EIS) in October 2011, a legal mandate as part of the process of considering whether or not to grant approval for the development of Fermi 3.

This report will examine whether the EIS sufficiently addressed two subjects, i.e. the potential contamination from a new Fermi 3, and potential health risks of this contamination to local residents.

The contamination from reactors such as those at Fermi involves a process known as fission, which occurs when Uranium-235 is bombarded by neutrons. (Before this point, U-235 must be mined, milled, converted, enriched, and fabricated). This is exactly the same process in an atomic bomb explosion, except that the process in nuclear reactors is controlled.

As uranium atoms split, neutrons strike other U-235 atoms, causing a chain reaction in which extremely high heat is created. Breaking U-235 atoms apart also creates several hundred new chemicals, known as fission and activation products. They are not found in nature, but formed by the re-arrangement of protons, neutrons, and electrons from the old U-235 atoms.

Some of these chemicals have become well known during the atomic era of the past 65 years, including Iodine-131, Cesium-137, and Strontium-90. Despite efforts by reactor operators to contain these chemicals within the reactor building, some must be routinely emitted into the air and water, during daily operations and refueling. These metal particles and gases are returned to the earth through precipitation. They enter the human

body by breathing and the food chain, where they kill and injure cells by emitting alpha particles, beta particles, or gamma rays. A damaged cell may or may not repair itself; if it fails to do so, it will duplicate into similarly damaged cells, which can lead to mutations and cancer.

While all humans are harmed by fission products, the fetus, infant, and child are most affected. Adult cell division is relatively slow, giving a damaged cell a better chance for repair. But fetal and infant cells divide at a very rapid rate, making repair of the damage less likely. The fetal and infant immune system is also relatively immature, making it less likely to fight off mutations that can become cancer.

The cocktail of over 100 chemicals attacks various parts of the body. Radioactive iodine attaches to the thyroid gland. Strontium seeks out bone and teeth, and penetrates into the bone marrow. Plutonium enters the lung. Cesium disperses throughout the muscles. Thus, exposure to the mix of radioactive elements can raise risk of many diseases, not just bone or thyroid cancer.

RADIOACTIVE CONTAMINATION PRODUCED BY FERMI – ACTUAL AND POTENTIAL

Possibility of Meltdowns. The radioactivity produced by nuclear reactors like those at Fermi can be released into the environment, and thus into human bodies, in large amounts (via a meltdown) or smaller amounts (via routine releases or deliberate releases). The EIS does not adequately address potential and actual radioactive emissions from Fermi. It minimizes the chance of a meltdown, which can occur from human error (like Chernobyl or Three Mile Island), act of sabotage (terrorist organizations have been known to target U.S. reactors), or act of nature (like Fukushima). In addition, human error (along with mechanical problems) accounted for a partial meltdown at Fermi 1 in 1966, which came dangerously close to a huge environmental release of radioactivity.

In 1982, Sandia National Laboratories reported to Congress the number of humans that would be affected by a worst-case meltdown near each U.S. nuclear plant. The figures for a meltdown at Fermi 2 included 8,000 deaths from acute radiation poisoning and 13,000 cancer deaths within 15 miles, along with 340,000 non-fatal cases of acute radiation poisoning within 70 miles. The figure of 340,000 is the highest of any U.S. reactor except for Limerick, located near Philadelphia. (Calculation of Reactor Accident Consequences, or CRAC-2, reported to the House Committee on Interior and Insular Affairs Subcommittee on Oversight and Investigations, November 1, 1982).

Although any meltdown would have devastating consequences, such an event at Fermi 2 would be especially harmful. According to 2010 U.S. Census data, while just 92,377 persons live within 10 miles of the plant, 4,799,526 live within 50 miles, including the metropolitan areas of Detroit MI, Toledo OH, and Windsor Canada. (Source: Dedman B. Nuclear neighbors: Population rises near US reactors, msnbc.com, April 14, 2011. http://www.msnbc.msn.com/id/42555888/ns/us_news-life/. Accessed January 10, 2012).

The recent devastation at Fukushima just 10 months ago is a tragic reminder that the risk of a meltdown is all too real, and should be a major consideration when evaluating whether to bring new nuclear reactors on line.

Aging Reactors Operating Most of Time. For years, U.S. nuclear reactors operated barely half the time, due to frequent mechanical problems. But beginning in the late 1980s, utilities made upgrades that reduced shut down time, even correcting mechanical flaws while reactors continued to operate. In addition, "refueling" nuclear reactors is now done much less often (about every 18 months), and the time that a reactor is shut down for refueling, a complex process, has been greatly reduced, to several weeks.

While this practice is a positive one from a financial point of view, it raises concerns from a health standpoint. Reactors are aging – virtually all are at least 25 years old – and their parts are becoming increasingly brittle and susceptible to breakdown. The practice of keeping reactors in operation more of the time is akin to driving an old car with many miles on it increasingly long distances.

Table 2 shows that the Fermi 2 plant operated 91.0% of the time from 2000-2005, a figure roughly equal to the national rate. The U.S. Nuclear Regulatory Commission stopped publishing monthly hours of operation on its web site several years ago; but even though exact figures are not known, it is highly likely that post-2005 capacity is similar to the prior several years.

A high capacity factor increases the probability of meltdowns. It also increases the likelihood of routine emissions of radioactivity escaping into the environment.

Table 2
Percent Capacity (% of time in operation)
Fermi 2 Reactor, 2000-2005

Year	Hrs. Critical	Total Hrs.	% Capacity
2000	7696.5	8784	87.6
2001	7967	8760	90.9
2002	8646	8760	98.7
2003	7614	8760	86.9
2004	7905	8784	90.0
2005	8032.8	8760	91.7
TOTAL	47861.3	52608	91.0

Source: U.S. Nuclear Regulatory Commission, www.nrc.gov.

Near Miss Accidents. In 2006, the group Greenpeace published an analysis of "near miss" meltdowns at U.S. nuclear reactors in the 20 years since Chernobyl. There were 200 such events on the list, and two occurred at Fermi 2. On January 28, 2001, the reactor's emergency diesel generator was inoperable for more than seven days. On August 14, 2003, the reactor experienced a loss of offsite power due to the blackout in the northeast U.S. (Source: An American Chernobyl: Nuclear "Near Misses" at U.S. Reactors Since 1986, www.greenpeace.org).

Shut Downs for Over a Year. Also in 2006, the Union of Concerned Scientists published a list of U.S. nuclear reactors that had been closed for at least a year. One was Fermi 1, which was closed from October 5, 1966, when it experienced a partial meltdown, and did not re-start until July 18, 1970. The reactor operated very little thereafter, and closed permanently two years later.

The other long outage occurred at Fermi 2, from December 25, 1993 to January 18, 1995, a total of 13 months. (Source: Union of Concerned Scientists: Unlearned Lessons from Year-Plus Reactor Outages, www.ucsusa.org).

Actual Emissions. Each utility company operating a nuclear reactor is required by law to measure actual emissions of various types of radioactivity into the environment. There are various chemicals included in these reports, but several show that Fermi 2 may be among the reactors with the greatest emissions in the U.S.

One type of chemical reported is Iodine-131, produced only in nuclear reactors and weapons tests. In the year 2002, for example, Fermi 2 released the 10th highest amount of I-131 into the air, out of 68 reactors with reported emissions. The Fermi total of 9,280 microcuries of I-131 was far above the median of 496 for the 68 reactors (Table 3). I-131 has a half life of 8 days, and seeks out the thyroid gland, where it destroys and injures cells.

Table 3
U.S. Reactors with Greatest Emissions of Airborne I-131, 2002
(Total 68 Reactors, Medican Microcuries = 496)

Reactor	Microcuries
1. LaSalle 1 IL	316000
2. Browns Ferry 1 AL	275000
3. Vogtle 1 GA	20500
4. San Onofre 2 CA	17300
5. Salem 2 NJ	16500
6. Oyster Creek NJ	13700
7. Fort Calhoun NE	10900
8. Brunswick 1 NC	10300
9. Palo Verde 2 AZ	9740
10. Fermi 2 MI	**9280**

Source: U.S. Nuclear Regulatory Commission, Radiation Exposure Information and Reporting System (www.reirs.comm/effluent).

In addition, Fermi 2 released a relatively high total of Strontium-89 into the air in 2002. Its total of 418 microcuries ranked 7th highest of 33 reactors with reported releases, and its total was far above the national median of 36 microcuries (Table 4). Radioactive strontium seeks out bone and penetrates into the bone marrow, where the white blood cells so important to the immune system are formed. Sr-89 has a half life of 50 days.

Table 4
U.S. Reactors with Greatest Emissions of Airborne Sr-89, 2002

Reactor	Microcuries
1. Oyster Creek NJ	8630
2. LaSalle 1 IL	7350
3. Cooper Station IL	1980
4. Quad Cities 1 IL	1850
5. Dresden 2 IL	986
6. Nine Mile Point 1 NY	655
7. Fermi 2 MI	**418**
8. Browns Ferry 1 AL	355
9. Vermont Yankee VT	281
10. River Bend LA	199

Source: U.S. Nuclear Regulatory Commission, Radiation Exposure Information and Reporting System (www.reirs.com/effluent).

There is also evidence that Fermi 2 emissions are relatively high for periods more recent than 2002. Table 5 shows the volume of gaseous emissions of tritium during 2007 from U.S. nuclear plants. Of the 60 plants with reporting data, Fermi ranks 13th highest. Its total of 124.60 curies ranks well above the U.S. median of 55.23.

Table 5
U.S. Nuclear Plants with Greatest Emissions of Airborne Tritium, 2007
(Total 60 Plants, Median Curies = 55.23)

Plant	Curies
1. Palo Verde AZ	1934.7
2. Hope Creek/Salem 1-2 NJ	414.1
3. Cook 1-2 MI	291.4
4. Brunswick 1-2 NC	256.0
5. Harris NC	235.9
6. McGuire 1-2 NC	204.3
7. Diablo Canyon 1-2 CA	193.7
8. Catawba 1-2 SC	187.9
9. Nine Mile Point 1-2 NY	158.1
10. St. Lucie 1-2 FL	138.1
11. Waterford LA	131.8
12. Sequoyah 1-2 TN	131.2
13. Fermi 2 MI	**124.6**

Source: U.S. Nuclear Regulatory Commission, Radiation Exposure Information and Reporting System (www.reirs.comm/effluent).

Gaseous tritium emissions appear to be rising over time. Table 6 shows the amount of reported emissions for each year from 2001 to 2007. Although not all quarterly reports showed actual emissions, it still appears that levels are rising over time.

Table 6
Gaseous Tritium Releases, by Year, 2001-2007, Fermi 2 Plant

Year	Quarters Reported	Curies
2001	1	1.31
2002	2	1.23
2003	3	23.66
2004	4	101.50
2005	0	----
2006	4	111.30
2007	4	124.60

Source: U.S. Nuclear Regulatory Commission, Radiation Exposure Information and Reporting System (www.reirs.comm/effluent).

DEMOGRAPHICS - AREA CLOSEST TO VOGTLE

Fermi is located in southeastern Monroe County, which means that all residents live within 20 miles of the Fermi plant, and the majority of residents live within 10 miles. Because of this proximity, and because the National Cancer Institute 1990 study of cancer near nuclear plants selected Monroe County as the "local" area closest to Fermi, this study will also use the county as the focal area of analysis.

There are limits by using the county as the study area. Prevailing winds tend to blow towards the east, i.e. into Lake Erie, and thus local residents may not absorb the greatest doses of radioactivity released from Fermi. Using the entire county does not examine whether there are health differences in Monroe County populations closest to Fermi vs. those further away – essentially because of the difficulty in obtaining sub-county health data. However, winds swirl, propelling Fermi radioactivity not just to the east, but to the west, north, and south. The municipal water supply is located very close to Fermi. And fish caught in Lake Erie are most likely to be consumed by local residents. For these reasons, Monroe County should be a relatively meaningful area

Demographic characteristics of Monroe County, compared to the state and nation, are given in Table 7 below:

Table 7
Demographic Characteristics, Monroe County vs. Michigan vs. U.S.

Category	Monroe	Michigan	United States
2010 population	152,021	9,883,640	308,745,538
2010 % < 18 years	24.1	23.7	24.0
2010 % > 65 years	13.4	13.8	13.0
2010 % Female	50.7	50.9	50.8
2010 % White	94.4	78.9	72.4
2010 % Black	2.1	14.2	12.6
2010 % Asian	0.6	2.4	4.8
2010 % Hispanic	3.1	4.4	16.3
2010 % White non-Hisp.	92.5	76.6	63.7
2005-09 % Foreign born	1.9	6.0	12.4
2005-09 % High School grad	87.7	87.4	84.6
2005-09 % College grad	17.1	24.5	27.5
2009 % Below Poverty	10.7	16.1	14.3
2009 Median Household Inc.	$53,224	$45,254	$50,221

Note: Percent high school and college graduates are for adults over age 25. Source: U.S Bureau of the Census, www.census.gov, state and county quick facts.

With a population just over 150,000, Monroe County is similar to the state and nation in terms of gender and age distribution. The proportion of residents that are minorities is much lower in Monroe, as is the percent of foreign born. The percent of college graduates is low, but so is the percent living below poverty.

While there are differences in demographics between Monroe compared to Michigan and the United States, these differences have existed for many years. Therefore, temporal trends over time are appropriate when comparing Monroe County to the state and nation.

This report will examine changes in health status before and after the startup of Fermi 2, using official data from a variety of health indicators.

LOCAL TRENDS IN RADIATION-SENSITIVE HEALTH INDICATORS SINCE STARTUP OF FERMI 2 REACTOR

Infant Deaths. The segment of the population that is most susceptible to the damage inflicted by radiation exposure is the fetus and infant. The very young have immature immune systems; and their cells are dividing so rapidly compared to adults there is less of a chance that a fetal/infant cell damaged by radiation can self-repair before dividing – into more damaged cells.

Data are available for several types of infant and fetal health indicators at the county level. The first is infant deaths, which is one of the more commonly used indicators of a society's health. Annual infant deaths and death rates for each U.S. county is available from the U.S. Centers for Disease Control and Prevention, for the 30 year period 1979 to 2008. This means a baseline period of 1979-1984 – after the shut down of Fermi 1 and before the startup of Fermi 2 – can be used, in comparison to the period 1985-2008.

Table 8 below shows the Monroe County infant death rate (under 1 year old) compared to the U.S. rate for the pre- and post-startup period of Fermi 2.

Table 8
Death Rates, Infants <1, 1979-1984 vs. 1985-2008
Monroe County MI vs. United States

	Rate (No. of Deaths)		
Period	Monroe	U.S.	% Monroe vs. U.S.
1979-1984	903.1 (110)	1183.5	- 23.7%
1985-2008	672.0 (293)	801.2	- 16.1%
% Change			**+ 7.6%** p<..29 (NS)

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov. Rates represent number of deaths per 100,000 live births.

Monroe's pre-Fermi infant death rate was 23.7% below the U.S., which has risen to 16.1% below thereafter. The increase fell short of being statistically significant (p<.29, when p<.05 is significant). In the most recent decade, the county rate was just 10.1% below the U.S., meaning the traditionally low county infant death rates is gradually approaching the national average, the longer the reactor operates.

Because of the great racial disparity in infant deaths, it would be helpful to examine the same changes for whites only, given in Table 9:

Table 9
Death Rates, Infants <1, 1979-1984 vs. 1985-2008, Whites
Monroe County MI vs. United States

	Rate (No. of Deaths)		
Period	Monroe	U.S.	% Monroe vs. U.S.
1979-1984	831.4 (99)	1021.3	- 18.6%
1985-2008	643.8 (271)	668.5	- 3.7%
% Change			**+14.9%** p<.12 (NS)

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov. Rates represent number of deaths per 100,000 live births.

The increase in white Monroe County infant death rates from 18.6% to 3.7% below the U.S. is sharper than that for all races. The rise falls short of statistical significance at p<.12. The county rate was actually 5.3% ABOVE the U.S. in the past decade (1999-2008), changing a below-average infant death rate to an above-average one.

The fact that there are few Hispanics in Monroe County has little effect on infant death rates. The county infant death rate for non-Hispanic whites in the past decade is 2.5% greater than the U.S., based on 93 deaths.

Low Weight Births. Another means of measuring infant and fetal health is the percentage born under weight. Public health officials generally classify births below 2500 grams (5.5 pounds) as under weight, and those under 1500 grams (3.3 pounds) as very under weight.

The Michigan Department of Community Health web site displays annual birth weight data for each Michigan county and the state total, for each year from 1989-2009. Unfortunately, there are no data prior to Fermi's opening in 1985, but using several years immediately following Fermi 2 started can be substituted for a baseline period. Table 10 below compares the county and the state of Michigan from 1989-1990 and 1991-2009, for low weight and very low weight births.

Table 10
Rates of Low Weight and Very Low Weight Births, 1989-1990 vs. 1991-2009
Monroe County MI vs. United States

Period	Rate (No. Low Wt Births) Monroe	Mich.	% Monroe vs. Mich.
Low Weight Births			
1989-1990	5.14 (198)	6.69	- 32.2%
1991-2009	6.69 (2264)	7.98	- 16.1%
% Change			**+16.1%** p<.002
Very Low Weight Births			
1989-1990	0.78 (30)	1.09	- 49.3%
1991-2009	1.54 (367)	1.61	- 32.5%
% Change			**+16.8%** p<.12 (NS)

Source: Michigan Department of Community Health, www.michigan.gov/mdch, statistics and reports. Rates represent number of low weight births (<2500 grams) and very low weight births (<1500 grams) per 100 live births.

The county rate of births <2500 grams and <1500 grams both rose sharply, compared to the state of Michigan, since 1990. In the past two decades, the county rate is still below the state, but in recently there have been several years in which the county exceeded the state, suggesting again that the low rates in the county several decades ago are being replaced by higher ones.

The change for low weight births is highly significant (p<.002). In particular, the rate of very low weight births (<1500 grams) nearly doubled, from 0.78% to 1.54%, although it falls short of statistical significance (p<.12) due to the relatively small number of cases.

Childhood and Adolescent Cancer. Another expression of harm from radiation exposure early in life is cancer to the child and adolescent. Damaged fetal and infant cells may take years before manifesting as an actual cancer that is diagnosed. Childhood cancer may be the most-studied health measure after radiation exposure, as there are dozens of medical journal articles published on this topic.

The CDC mortality web site from 1979-2008 can be used to examine trends in Monroe County's child and adolescent cancer rates. Child cancer incidence often uses age 0-19; because cancer deaths often take several years to occur, Table 11 can use cancer deaths age 0-24. Again, the period 1979-1984 (before Fermi 2) is used as a baseline, compared with the 24 years following.

Table 11
Cancer Death Rates Age 0-24, 1979-1984 vs. 1985-2008
Monroe County MI vs. United States

	Rate (No. of Deaths)		
Period	Monroe	U.S.	% Monroe vs. U.S.
1979-1984	3.699 (13)	4.889	- 24.3%
1985-2008	4.444 (55)	3.470	+28.1%
% Change			**+52.4%** p<.004

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov. Rates represent number of deaths from cancer per 100,000 persons. The ICD-9 codes used for the years 1979-1998 are 140.0-208.9, and the ICD-10 codes used for 1999-2008 are C00-C97.9.

In the years prior to the startup of Fermi 2, the local cancer death rate age 0-24 was 24.3% below the U.S. But in the years following, the local rate rose, while the national rate declined. The county rate in the period 1985-2008 was 28.1% ABOVE the U.S., based on 55 deaths (significant at p<.004). Moreover, in the most recent decade (1999-2008), the county rate was 50.2% higher (4.631 vs. 3.083 deaths per 100,000), suggesting rates are getting higher with time, and as the Fermi 2 reactor ages and its parts become more brittle.

Cancer in Young Adults. If children and adolescents are most sensitive to developing cancer from radiation exposure, it is a logical assumption that the next most sensitive group are young adults, defined in this analysis as age 25 to 44. CDC data on changes in Monroe vs. U.S. rates since Fermi 2 started up are presented in Table 12.

Table 12
Cancer Death Rates Age 25-44, 1979-1984 vs. 1985-2008
Monroe County MI vs. United States

	Rate (No. of Deaths)		
Period	Monroe	U.S.	% Monroe vs. U.S.
1979-1984	21.263 (49)	27.254	- 22.0%
1985-2008	25.581 (262)	24.593	+ 4.0%
% Change			**+26.0%** p<.05

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov. Rates represent number of deaths from cancer per 100,000 persons. The ICD-9 codes used for the years 1979-1998 are 140.0-208.9, and the ICD-10 codes used for 1999-2008 are C00-C97.9.

The county rate before Fermi 2 started up was 22.0% below the U.S., but has since been 4.0% above the U.S., based on 262 deaths from 1985-2008 (significant at p<.05). In the most recent decade of 1999-2008, Monroe's rate was 8.4% greater (based on 103 deaths), indicating again that local rates are continuing to rise over time.

Cancer Mortality – Very Elderly. Aside from younger populations, the group that is most sensitive to damaging effects of radiation is the very elderly, whose immune systems are becoming weaker, making them less likely to fight off a carcinogen such as radiation.

Table 13 shows the change in cancer death rates for Monroe County residents age 75 and older, compared to the U.S., in the periods before and after Fermi 2 started up.

Table 13
Cancer Death Rates Age 75+, 1979-1984 vs. 1985-2008
Monroe County MI vs. United States

	Rate (No. of Deaths)		
Period	Monroe	U.S.	% Monroe vs. U.S.
1979-1984	1375.5 (376)	1318.7	+ 4.3%
1985-2008	1505.7 (2462)	1412.08	+ 6.6%
% Change			**+ 2.3%** p<.67

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov. Rates represent number of deaths from cancer per 100,000 persons. The ICD-9 codes used for the years 1979-1998 are 140.0-208.9, and the ICD-10 codes used for 1999-2008 are C00-C97.9.

The Monroe County increase from 4.3% higher to 6.6% higher is not as dramatic as those larger increases for younger populations. The change is not statistically significant, but does represent a large number of deaths (2462 Monroe County residents age 75 and older died of cancer from 1985-2008). In the most recent decade (1999-2008), the county rate was 10.2% above the nation, suggesting that the increase is continuing in the Fermi 2 era.

Cancer Mortality – All Ages. The Monroe County and U.S. changes in cancer mortality for persons of all ages before and after Fermi 2 startup were also examined. These figures are adjusted to account for age distribution, a commonly used epidemiological method when examining populations of all ages. Table 14 indicates these changes.

Table 14
Cancer Death Rates All Ages, 1979-1984 vs. 1985-2008
Monroe County MI vs. United States

	Rate (No. of Deaths)		
Period	Monroe	U.S.	% Monroe vs. U.S.
1979-1984	211.27 (1231)	207.83	+ 1.7%
1985-2008	213.25 (6540)	200.45	+ 6.4%
% Change			**+ 4.7%** p<.14 (NS)

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov. Rates represent number of deaths from cancer per 100,000 persons, adjusted to the 2000 U.S. population. The ICD-9 codes used for the years 1979-1998 are 140.0-208.9, and the ICD-10 codes used for 1999-2008 are C00-C97.9.

Monroe County's cancer death rate rose from 1.7% to 6.4% above the U.S. after Fermi 2 began operating. A total of 6540 deaths among county residents occurred in the 24-year period 1985-2008, but the change fell short of statistical significance at p<.l4. During the most recent decade (1999-2008), the county rate was 8.6% above the U.S., indicating that the increase is continuing. The racial mix doesn't affect the rates much; in the period 1999-2008, the rate for non-Hispanic whites in Monroe County was 6.0% greater than the U.S., compared to 6.4% for all races.

The National Cancer Institute published a study in 1990 entitled "Cancer in Populations Living Near Nuclear Facilities." The study examined cancer death rates near 62 U.S. nuclear plants in 5-year groups from 1950 to 1984, for all cancers combined and for 13 types of cancer. The study included statistics for Monroe County as that closest to the Fermi plant. Source: National Cancer Institute. Cancer in Populations Living Near Nuclear Facilities. NIH Pub. No. 90-874. Washington DC: U.S. Government Printing Office, 1990.

In the five-year period 1974-1978, after Fermi 1 had closed and before Fermi 2 had begun operating, the county mortality rate for all cancers combined was 11.3% below the U.S., based on 788 deaths. Thus, if this period was combined with 1979-1984, the Monroe cancer rate was below the U.S. – yet another example of a Monroe death rate below the nation before Fermi 2 was put into operation, only to approach or exceed the U.S. average after the reactor went critical.

Cancer Incidence, Most Common Cancers. While historical cancer mortality (death) data is available for the past 30 years for each state, such is not the case for cancer incidence (cases). Each state developed its cancer registry for newly-diagnosed cases at a different point in time, and thus the National Cancer Institute makes state- and county-specific incidence data available only for the period 2004-2008, making any historical trend analysis impossible.

However, the Michigan Department of Community Health makes annual county-specific cancer incidence data available on its web site beginning in 1985 and ending in 2007. All cancers combined are provided, along with the four most common malignancies (female breast, colorectal, lung, and male prostate), which make up about 55% of all diagnosed cases of cancer.

While there is technically no data prior to the startup of Fermi 2 in 1985, the period 1985-1987 can serve as a "before startup" period, since most cancers that would be affected by emissions from Fermi 2 would occur at least two years after startup. Thus, Table 15 shows the changes in incidence for Monroe vs. the U.S., for the periods 1985-1987 and 1988-2007.

Table 15
Cancer Incidence Rates, All Ages, 1985-1987 vs. 1988-2007
Monroe County MI vs. United States

Period	Rate (No. of Deaths) Monroe	U.S.	% Monroe vs. U.S.
All Cancers Combined			
1985-1987	268.5 (868)	456.1	- 41.1%
1988-2007	434.7 (11514)	483.4	- 10.1%
% Change			**+30.0%** p<..000001
Female Breast Cancer			
1985-1987	64.1 (113)	128.5	- 50.2%
1988-2007	101.1 (1481)	132.6	- 23.7%
% Change			**+26.5%** p<..00001
Colorectal Cancer			
1985-1987	34.0 (104)	64.4	- 47.3%
1988-2007	53.1 (1358)	54.6	- 2.8%
% Change			**+44.5%** p<..00001
Lung Cancer			
1985-1987	52.5 (174)	66.1	- 20.6%
1988-2007	75.0 (1977)	65.8	+ 14.0%
% Change			**+34.6%** p<..00001
Male Prostate Cancer			
1985-1987	58.9 (61)	122.8	- 52.0%
1988-2007	134.7 (1479)	177.5	- 24.1%
% Change			**+27.9%** p<..00002

Sources: Michigan Cancer Registry, http://www.michigan.gov/mdch/0,4612,7-132-2944_5323---,00.html (Monroe County data). Surveillance, Epidemiology, and End Results system (www.seer.cancer.gov, Cancer Statistics Registry, 1975-2008). U.S. rates consist of the states of Connecticut, Hawaii, Iowa, New Mexico, Utah, and the metropolitan areas of Atlanta, Detroit, San Francisco, and Seattle, Rates represent number of cancer cases per 100,000 persons, adjusted to the 2000 U.S. population.

For all cancers combined, and for each of the four most common cancers, the Monroe County incidence rate was below the U.S. in 1985-1987. All of the rates rose in the next 20-year period, although all are still below the U.S. (except for lung cancer, which is now 14% higher). The large numbers of cancer cases (11,514 in the 20 year period 1988-2007) make the results for each of the five cancer types highly statistically significant.

Mortality, All Other Causes. Cancer is disease most strongly linked with the hazardous health effects of radiation exposure. However, the fact that radiation from nuclear

reactors destroys and injures cells, impairing the immune system's ability to fight disease can increase the risk of other conditions such as heart, digestive, and respiratory diseases.

Table 16 shows the change in Monroe vs. U.S. mortality rates for all causes of death except for cancer, for the pre- and post-Fermi 2 startup periods.

Table 16
Non-Cancer Death Rates All Ages, 1979-1984 vs. 1985-2008
Monroe County MI vs. United States

	Rate (No. of Deaths)		
Period	Monroe	U.S.	% Monroe vs. U.S.
1979-1984	814.84 (4441)	794.01	+ 2.6%
1985-2008	703.03 (20507)	676.30	+ 4.0%
% Change			**+ 1.4%** p<.41 (NS)

Source: U.S. Centers for Disease Control and Prevention, http://wonder.cdc.gov. Rates represent number of deaths from cancer per 100,000 persons, adjusted to the 2000 U.S. population. The ICD-9 codes used for the years 1979-1998 are all except 140.0-208.9, and the ICD-10 codes used for 1999-2008 are all except C00-C97.9.

The non-cancer death rate in Monroe County made a modest increase from 2.6% to 4.0% since Fermi 2 began operating, not significant at p<.41. The 4.7% excess for the most recent decade (1999-2008) was greater than the prior periods (2.6% for 1979-1984, and 3.3% for 1985-1998), showing a steady rise continuing into the most current period

Hospitalization Rate. The state of Michigan Department of Community Health also provides county-specific data on rates of hospital admissions for the period 2004-2008. While trend analysis is not possible, comparing Monroe County with the state may be indicative of potential health problems. Table 17 provides current hospitalization rates for all causes, plus cancer and birth defects, the conditions most closely connected with radiation exposure.

Table 17
Hospitalization Rates, 2004-2008, Selected Conditions
Monroe County MI vs. Michigan

Period	Rate (No. Hospitalizations) Monroe	Mich.	% Monroe vs. Mich.
All Ages			
All Causes	1399.2 (107,465)	1315.6	+ **6.3%** p<.000001
Malignant Cancer	43.7 (3360)	42.3	+ **3.3%** p<.68 (NS)
Benign neoplasms	20.4 (1570)	14.8	**+37.8%** p<.000001
Age <18			
Congenital anomalies	10.8 (200)	10.4	+ **3.8%** p<.71 (NS)
Malignant cancer	3.2 (60)	2.5	**+28.0%** p<.18 (NS)

Source: Michigan Department of Community Health, www.michigan.gov/mdch, statistics and reports. Rates represent number of hospital admissions per 10,000 persons.

The hospitalization rate for Monroe County was 6.3% higher than the state for the period 2004-2008, which is significant due to the very large number of admissions (107,465). In 2009, the county rate of 1477.1 was 11.7% greater than the state rate of 1322.7 per 10,000 persons, based on 22,559 hospitalizations, signaling that the county-state gap may be growing.

Hospitalization rates for cancer – both malignant and benign – of all ages were greater in Monroe County vs. the state, as were rates for children under age 18 for cancer and congenital anomalies (birth defects). Of the five hospitalization measures here, two were statistically significant.

DISCUSSION

The proposed new Fermi 3 nuclear reactor raises a number of health concerns that should be addressed before any decision is made on whether to allow the reactor to be constructed. Assessing the potential environmental impact of Fermi 3 would be much more evidence-based if a "report card" on the performance of previous Fermi reactors, especially Unit 2, were part of the assessment. Unfortunately, the U.S. Nuclear Regulatory Commission does not require any such review, and thus, the EIS for Fermi 3 did not address the record of operations and health risks to the local population.

This report analyzes data on Fermi 2 in two areas: environmental contamination and trends in local health status. The environmental contamination section first addressed releases from a meltdown. Because of the 1966 meltdown at Fermi 1; the aging, corroding reactor at Fermi 2; and the reality that human error (Chernobyl), act of nature (Fukushima), and act of sabotage (if a terrorist attack struck a reactor) could cause a devastating meltdown at a plant with 4.8 million residents within 50 miles, the meltdown threat posed by a Fermi 3 is serious and should be strongly weighed in any decision on whether to allow its building.

The other type of radioactive contamination addressed in this report was that of emissions routinely released into the environment by Fermi 2. Several types of radioactive chemicals were examined, and in each, Fermi's releases were greater than most U.S. nuclear reactors.

This report then examined trends in a variety of health status indicators since the 1980s, before and just after Fermi 2 came online. The Monroe County disease or death rate was compared to the state or national rate, for the "before" and "after" periods. The indicators were those believed to be most sensitive to radiation exposure, including infant deaths, low weight births, cancer mortality (all ages, children, young adults, and the very elderly), cancer incidence (all cancers, plus breast, colorectal, lung, and prostate cancer), plus hospitalization rates for cancer and birth defects.

For 19 of 19 indicators, the increase in the Monroe County rate exceeded the increase for the state or nation. Of these, 10 achieved statistical significance, with 4 others that approached significance. More analysis is merited here, but these strongly consistent findings should be taken seriously.

In closing, basic data on the performance of Fermi 2 strongly suggests Fermi 3 will pose a safety and health risk for local residents. Accordingly, the conclusion of this report is that no decision should be made on whether or not to approve a license for Fermi 3 until more research of this type is undertaken. A baseline health study by independent experts is needed, along with a thorough public education and discussion process, to ensure whether the majority of local people approve of the new reactor after acquiring this additional knowledge.