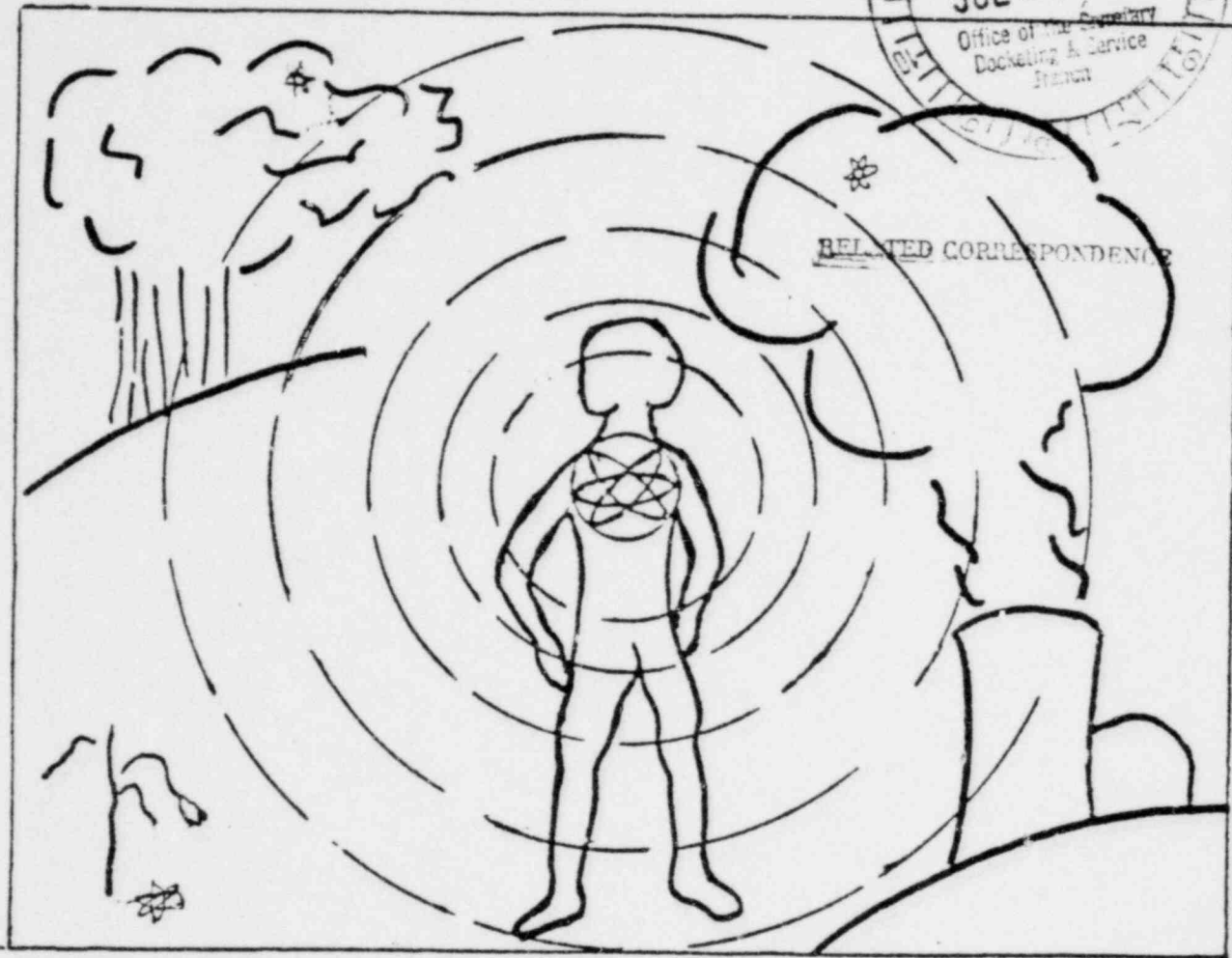


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NUCLEAR WASTE

THE TIME BOMB

IN OUR BONES

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This is the way the world ends  
This is the way the world ends  
This is the way the world ends  
Not with a bang but a whimper.

—T. S. Eliot

This publication is a summary of:

"Toward a Realistic Fission Dose Estimate:  
Methodology and Case Study"

by

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John W. Gofman, Ph.D., M.D.

The study is published in full with detailed documentation  
and bibliography in:

METHODOLOGIES FOR THE STUDY OF LOW-LEVEL RADIATION  
IN THE MIDWEST

by

Charles W. Huver, Ph.D. (University of Minnesota)

Gertrude A. Dixon, Naomi Jacobson and George I. Dixon

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## NUCLEAR WASTE: THE TIME BOMB IN OUR BONES

Atomic waste--the ugly by-product of the miracle of fission--is threatening the expansion of the lucrative nuclear power industry and "modernization" of the nuclear weapons arsenal. Around the world, nuclear promoters are recognizing that the "public's perception" of the "waste problem" will determine the calculability of their product.

It is too late to hide the monster with promises of military dominance and plentiful energy. The fact that nuclear wastes will cause cancers, genetic damage, "ill health," has taken root in the public mind and no amount of skillful surgery by the mind-bending tactics of nuclear salesmen can eradicate it.

But exactly what IS "nuclear waste" and how large are the risks?

The public perception of the risks cannot be denied but it can be minimized by the oldest tricks of public opinion manipulation: by precise DEFINITION of the "waste problem" and expert QUANTIFICATION of the "risks." The tricks work. "Waste" becomes a comfortingly tangible thing--measured as so many cubic inches--securely "stored." And "risks," precisely calculated from a "dose" of so many millirems, are, after all, hardly "detectable."

These mysteriously derived "dose" numbers are the hard core of the nuclear sell--guaranteed to convince the public that the risks are, indeed, "acceptable"--that the ugly wastes can, indeed, be contained.

Somehow the numbers are convincing even though scientists have concluded that "all radiation doses," no matter how small, "result in some risk"--even though studies indicate that legally "allowed" doses HAVE caused cancers in federal nuclear workers, nuclear shipyard workers, soldiers and civilians exposed to bomb-testing fallout, citizens near older nuclear reactors and weapons facilities.

But these latent cancers, appearing years after radiation exposure, are not DEFINED as products of nuclear "waste." LOW-LEVEL radiation is the label attached to them--an innocuous term. But, LOW-LEVEL radiation IS the steady bombardment of body cells by fission products--the nuclear waste time bomb ticking away in bone and tissue.

In short, all radioactive fission "doses," above or below the "allowed" levels, are caused by nuclear WASTE and by NOTHING ELSE. Wastes temporarily stored, seeping from tanks, ditches, barrels, fuel rods--wastes in the winds and waters--wastes already "stored" in soil, food, oceans--and wastes permanently in residence in living body cells. Wastes DEFINED as "acceptable normal operating releases" or "fallout"--on rare occasions, admitted to have "abnormally" leaked from a reactor or weapons test.

All are produced by the same fission process in predictable amounts per unit of nuclear energy or megatons of nuclear bombs; all have a lifetime of fission decay set by the laws of physics. Low-level radiation is the nuclear waste which is EXPECTED to escape any future "safe" storage plan, "lost on the way to the bank" as Dr. John Gofman aptly describes it. Daily it finds a home in some individual's body. It is the "nuclear waste problem" that governments, the industry and most scientists DEFINE OUT because no one EXPECTS a solution short of a halt to its creation.

The "dose" numbers which define this unavoidable amount of escaping atomic waste are crucial since public acceptance of fission depends upon proof that practically all waste can be isolated from human beings. The fission dose numbers, clothed in the aura of expertise, are always a minor fraction of the total radiation dose (which includes natural background and X-rays)--ranging from less than a tenth of a percent to a maximum of two percent.

How are these magic numbers derived? The Land Educational Associates Foundation (LEAF) research team decided to investigate the brewing secret of this cure for the ailing public image of nuclear power.

The most obvious strategy in the dose numbers game is the practice of giving the public the impression that an admitted PART of the fission dose IS the WHOLE dose. Thus newspapers may

occasionally report estimated doses (or "no detectable hazard") from a single leak at a particular reactor or from one bomb test. But the public is never explicitly told that only "abnormal" leaks which force closing down of a reactor are REQUIRED to be publicized--that the record of "normal" releases and less serious abnormal leaks remain buried in reports to the Nuclear Regulatory Commission (NRC). Bomb-testing reports usually refer to U.S. fallout from foreign bomb tests, not to releases from our own weapons facilities or bomb tests.

The dose numbers are never based on measurements of all 189 radionuclides produced by a fission event listed by the NRC. Often only ONE of these radioactive poisons is even measured.

Furthermore, the dose from this one radionuclide (or 2 or 3) is reported as detected in only one pathway to man even though radioactivity roams freely in man's whole environment. The practice is condoned by definition of a "critical pathway" for a "critical radionuclide."--the radiation route which is expected to produce the largest PART of the dose; by no means, the WHOLE dose. Thus, agencies may report "external" air dose from Kr-85 only or "internal" dose from Co-137 in milk only. The public is not aware that the air contains a multitude of radioactive poisons or that many radionuclides have been detected in milk or that most of the foods they consume are radioactively contaminated.

"Critical organs" for each radionuclide are also established, limiting the biological impact of a poison to only one part of the body--the organ receiving the most, but not all, of the dose. Thus for Sr-90 the "critical organ" may be the bone, which does receive the largest part of the radiation dose, and Sr-90 dose is often reported for bone only and whole body dose is omitted. Whole body dose is used to determine the expected cancer risk and the Sr--90 can constitute MOST of the whole body dose, especially to a child. Thus, cancer risks can be grossly minimized by this categorization of "critical" radionuclides, pathways or body organs.

The most significant WHOLE which the public never perceives is the lifetime accumulating nature of every radiation dose, large or small. At the most, the dose number for a whole year may be revealed but it is the year in and year out ACCUMULATED dose,

replenishing the wastes already stored in body cells, increasing the risks of cancers and genetic damage with each explosive decay, which is the WHOLE truth of this nuclear waste problem.

These parts-missing "dose" estimates are further diluted by the assumption that radiation is evenly distributed to every man, woman and child. Thus, estimates of "average population dose" from nuclear bomb-testing fallout assume world-wide dispersion and are published in terms of dose to hemispheres, despite the fact that scientists acknowledged twenty years ago that some areas could have at least ten times the rate of fallout as others. "First pass" citizens near nuclear facilities are also expected to get the highest doses from releases.

While estimates of radiation "dose" from nuclear facilities also assume equal dispersion, the "impact area" is a small definitely prescribed radius of one facility as though the same vagaries of wind and weather which carry atomic fallout from Nevada to Canada or China to New York did not apply to the waste releases from reactors. Thus the public is led to believe a nuclear reactor, ten or more miles distant, will not affect their health risks.

These diluted "average population dose" numbers also combine age-group doses into a single figure despite the fact, well-known by regulatory agencies, that children will have many times the adult dose from the same amount of radiation. An AEC-sponsored study at Columbia University in 1954-55, based on human bone samples, "showed the strong age-effect with young children carrying 10 times the concentration of Sr-90 as adults." The WHOLE dose to a CHILD never becomes public.

Most of these partial estimates which lull the public concern about the nuclear waste "dose" are predicated on an unrealistic basic methodology: calculations BEGIN with amounts of waste expected to be released from nuclear facilities, not from actual levels of radiation in man's environment as determined by monitoring. A recent report by a group of 14 Heidelberg (Germany) scientists who were independently asked to examine this methodology reveals a disturbing fact: The exposures to those living in the vicinity of nuclear reactors had been underestimated anywhere from 10 to 10,000 times, and this happened as a result of an arbitrary choice

of parameters for exposure pathways. The choices for calculation of the Sr-90 dose, for instance, turned out to be "the lowest experimental value of how the radionuclide went from soil to plant, then again the lowest value obtained for plant to beef cattle, then the lowest value for the factor of absorption by a given organ of the human body, and the lowest model for lifelong plateau. By the time all these values are multiplied together, the estimates of nuclear exposures become grossly misleading and understate the true risk by several orders of magnitude. The conclusion of the Heidelberg study was that a very serious public health problem had been created by this methodology." (Tutorium Umweltschutz an der Universität Heidelberg, Radioökologisches Gutachten zum Kernkraftwerk Wylh, May, 1978 as reviewed in Jeannine Honicker, Petitioner before the NRC in the Matter of Petition for Emergency and Remedial Action, Comments of the Petitioners's Staff on the NRC Staff Response to her Petition, January 1979.)

Yet, the US NRC continues to base reactor "doses" on how much waste a particular facility is "designed" to release. Defined as "goals" for limiting reactor releases, these doses are hundreds of times lower than the legally "allowed" dose LIMIT which is 5 times higher than natural radiation.

However, as proof positive that doses, are, indeed, so low, the NRC also promises, in every environmental impact statement, to carefully monitor radiation levels in the food chain. But, at an Environmental Protection Agency hearing the NRC revealed that the monitoring is not that precise after all--that it can only prove that the large legally allowed doses (not the small dose "goals") are not exceeded by reactor releases. In the words of Roger Mattson (NRC Director of Siting, Health and Safeguards): "Environmental monitoring is not used as the basis for determining the potential dose to individuals.... It would be impossible for routine monitoring programs TO DETERMINE ACTUAL DOSES TO REAL INDIVIDUALS."

This is a stranger-than-fiction Catch-22 situation: On one hand the public is absolutely assured that the fission dose IS CONSTANTLY MEASURED through the monitoring program; on the other hand, the EPA is told that the actual dose CANNOT be determined by monitoring.



Why should dose estimates be determined by guessing how much nuclear waste will be released from a reactor and how that waste will be distributed when actual measurements of the waste in the environment (food, air, water, soil) could be used instead?

The LAND/LEAF research team decided that a REALISTIC fission dose calculation could be made by starting with actual monitoring records rather than estimated waste releases and by developing a method to include as much of the WHOLE fission dose as possible. Such a realistic estimate of dose to a particular population in a particular geographical area could be tested against current "dose estimates." It could provide a more meaningful base for public assessment of the "risks" of nuclear waste already stored in body cells and the wisdom of producing more, than the publicized dose numbers generated by computers for an amorphous "population."

The research team found that milk radioactivity was monitored in Wisconsin by the Radiation Protection Section. No other foods were monitored by the state and only three of the major fission radionuclides were measured even in milk. However, it was possible to estimate the total diet content of these three contaminants with EPA data on proportions of dairy products to the total diet. The basic calculations, derived from actual local monitoring, was called the R<sup>D</sup> Diet Dose (3-Radionuclide Diet Dose). Additional proportions for external dose were available in United Nations and EPA studies for estimation of the Total Fission Dose.

In Wisconsin milk monitoring records were available for a 14-year period for 6 monitoring stations. Since NRC guides are available for deriving the millirem dose for each of 189 radionuclides for specific age groups, it was possible to calculate the lifetime accumulated dose for a Wisconsin teenager born at the start of the monitoring period (1963). A calculation was also made for the dose during those 14 years to an Adult. No state data was available for estimation of dose to those born in the early 1950's who would have accumulated the highest dose, having grown up during the atomic era. The research team estimated that this group (18 to 25-year-olds) would have accumulated a fission dose approximately 50% higher than those born in 1963.

In order to stay with data which could be absolutely verified

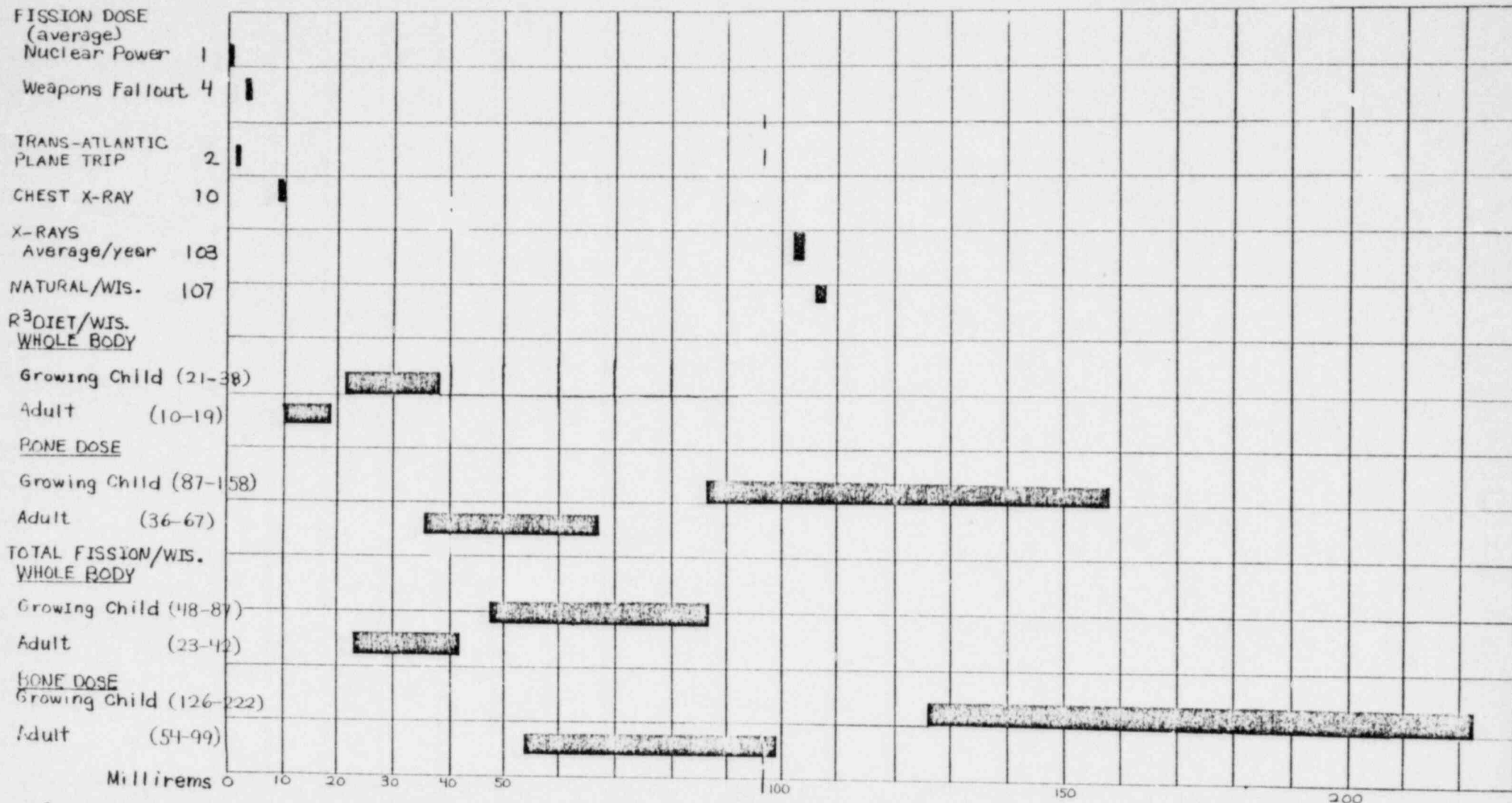
by state monitoring records, the research team had to omit many radiation sources which had not been monitored and could not be accurately estimated. The dose findings are, therefore, not the WHOLE dose. The conclusions are understatements of the actual dose particularly because of the following necessary omissions:

1. The R<sup>3</sup> Diet Dose includes ONLY the 3 monitored radionuclides (Strontium-90, Cesium-137 and Iodine-131) out of a possible 189 listed by the NRC. Studies have definitely established the presence of many other radionuclides in foods. Twelve others have been identified in milk alone.

2. Only one food, milk, is monitored by the state despite the fact that many other foods are known to absorb higher concentrations of radioactivity. Milk has been monitored because of the relative ease of collecting and testing, because it reflects changes in radiation levels more quickly and because large numbers of people may be affected by contamination. In a list of 19 calcium-contributing foods in the U.S., cow's milk ranks 13th for Sr-90 concentration. Scientists observed 15 years ago that people who derive most of their calcium from foods other than milk will have higher doses from Sr-90 than those who "dilute" their calcium diets with milk. The Atomic Energy Commission described the cow as a "decontaminator" in the radiation pathway to man since only a tenth of the radioactivity in the grass it consumes is secreted in its milk. Cs-137 concentrations are higher in meats, particularly venison, many fruits and vegetables and 25 times higher in goat's milk than in cow's milk. Foods especially high in radioactivity include potatoes, whole wheat, bananas, leafy vegetables, soy beans, berries, venison, nuts, cheese, cabbage. None of these foods are monitored by the state laboratory. Individuals with greater-than-average intake of these and other foods will have much higher doses than indicated by the LAND/LEAF research conclusions.

3. Drinking water is not included. It could be a major source of radiation for some individuals. Farm runoff, for instance, is recognized in the state as a major source of drinking water pollution. Concentrations of radioactivity in soil runoff are ten times higher than in residual soil. And, since the manure and urine of cows contains 10 times as much radioactivity as the milk, barnyard runoff could be a major contaminant.

ANNUAL FISSION RADIATION DOSE, WISCONSIN (1963-1976 average) COMPARED TO AVERAGE DOSE ESTIMATES



$R^3$  Diet Dose is from Sr-90, Cs-137, I-131 only in the diet  
 Total Fission Dose includes external dose calculated from U.S. estimates proportioned to  $R^3$  Diet.

4. Failure of the state to monitor milk with regularity, particularly Sr-90 in the summer months, could minimize the final estimates. The technical ability of the laboratory to detect the levels of contamination in milk is questionable--for instance, an EPA cross-check indicates that the laboratory has a tendency to underestimate the Cs-137 in milk except at very high levels. Cross-check samples were underestimated by up to 90%. The laboratory could obviously have sampled foods expected to have higher concentrations (such as goat milk or venison) with better precision. More than 150,000 deer were harvested in Wisconsin last year but no meats are monitored by the state.

5. Because of a lack of consumption and radioactive concentration data, the research team omitted all dairy products except milk and cheddar and cottage cheese. Dairy desserts, particularly, are consumed in large quantities in this state and would contribute additional doses.

These major limitations and omissions insure a large factor of conservatism in the LAND/LEAF dose estimates.

First, the research team calculated a "50-year Dose Commitment" using NRC age-specific dose guides. "Commitment" means exactly that: an iron-clad contract which spells out just how long each radionuclide will take up residence in the body and how many millirems of radiation dose it will deliver before it decays into a new generation of "daughter" radionuclides and finally dies. Man can create these previously non-existing radionuclides but he CANNOT destroy them nor can he shorten their pre-ordained lifespan. The body-cell lifetime of radionuclides varies from a few seconds to over 50 years--many outlive the body itself. Some do their damage quickly and die or are excreted--others take up residence in bone and tissue delivering only part of the dose "commitment" yearly, bombarding cells every day for years until their decay time, pre-ordained by the laws of physics, is completed. Some of the strontium-90 that found its way into a baby's milk bottle in the early 1950's is still in the cells of that individual. Every year it delivers an additional "annual" dose. Every year it increases that individual's risk of cancer.

NRC and EPA studies use dose "commitment" numbers because the commitment is REAL AND INEXORABLE. On the other hand, the public usually gets "annual" dose numbers. For Sr-90 the "annual" dose

is only 4.4% or less of the total dose "commitment". "Annual" dose numbers also frequently refer only to the dose delivered from food consumed in that year, excluding continuing annual doses from radioactivity absorbed in many previous years.

When the LAND/LEAF research team had calculated the dose commitments for Wisconsin, a very wide range of difference for age and area of residence was apparent immediately. Residents in the north-west-central section had accumulated a dose nearly twice as high as residents in the south and east section due, primarily, to a marked difference in bomb-testing fallout before the test-ban treaty in 1963. And the Growing Child had accumulated a total body dose twice as high as Adults and a Bone dose three times as high as Adults. Obviously the "average population" dose numbers are meaningless even for residents of an area as small as Wisconsin.

The LAND/LEAF research team also calculated the part of the 50--year commitment dose which had already decayed each year and delivered its "annual" radiation effect. This average "annual" fission dose during the 14-year period was compared to the claims by nuclear promoters that it is a very small fraction compared to natural radiation dose or X-rays which deliver an average annual dose of 100 to 125 millirems. Natural radiation is estimated to cause up to 10% of the spontaneous cancer deaths; the IARC estimates it causes 2,000 to 9,000 cancers annually, a conservative estimate. Dr. Karl Z. Morgan estimated in 1972 that diagnostic X-rays caused from 4,100 to 78,000 deaths per year in the U.S. More recent studies of radiation dose effects would raise these figures considerably.

The Whole Body radiation dose to Wisconsin citizens from just 3 radionuclides in food (the  $R^3$  Diet Dose) ranged from 10% to 36% of the annual X-ray or natural radiation dose. The  $R^3$  Diet Dose to the Bone ranged from a third of the natural or X-ray dose for a southeast Wisconsin adult up to one and a half times more than the natural dose for a child in northwestern Wisconsin. These doses were from only 3 radionuclides in food as indicated by monitoring by the state Radiation Protection Section. The estimated Whole Body Total Fission Dose ranged from 22% to 81% of the natural dose per year. These realistic estimates are not the tiny fractions

claimed by nuclear promoters.

The current increased risk of radiation-induced cancers to Wisconsin 14-year-olds was calculated on the basis of "annual" doses already delivered from decayed radioactivity by 1978. Risk estimates derived from the recent ERDA-sponsored study of cancer deaths among nuclear workers and an age-adjusted relative risk scale were used. In this analysis, a 100% increased risk is equal to double the normal cancer risk.

The radiation dose just from three radionuclides in their food has already increased the risk of myeloma and myeloid leukemia for Wisconsin 14-year-olds by 41% to 74% depending upon their area of residence. For the Total Fission Dose the increased risk was estimated to be from 93% to 168% higher than the normal risk.

For all cancers classified by the International Commission on Radiation Protection as High Sensitivity cancers for radiation-induction the current increased risks for this group ranged up to 20% from just the 3 radionuclides in food--up to 44% from the estimated Total Fission Dose. Cancers of the bone marrow, thyroid, lymph nodes, reticular tissue, pharynx, lung, pancreas, stomach and large intestine are classified as High Sensitivity cancers.

The average increased risk of ALL cancers was 13% (up to 18%) from the Total Fission Dose based on the risk estimate for males in the ERDA-sponsored study. On the basis of a smaller sample of females this study estimated that their cancer risk from radiation was much larger. Applying this less certain risk estimate to 14-year-old Wisconsin females, the LAND/LEAF research team calculated an average increased risk of all cancers of 51% (up to 70%) from the accumulated annual Total Fission Dose.

As alarming as these figures are, these young people are already COMMITTED to even higher risks, since only 35% to 40% of the radiation absorbed by their body cells during their lifetime (the "dose commitment") had decayed and delivered its risk effect by 1978. The rest will CONTINUE to radiate, delivering MORE dose constantly for the rest of their lives. Their risks of cancer will continue to rise with every disintegration of the restless radionuclides imprisoned in their body cells. This will happen EVEN IF NO NEW RADIATION IS ADDED. The future radiation doses each year

can be numerically predicted NOW with available NRC dose guides. -11-  
With fresh radiation doses, externally or internally, their risks  
will rise more steeply and for a longer time.

The IAND/LEAF research team calculated only the cancer risks  
but increased risks are just as certain for genetically damaged  
offspring, increases in genetically-derived diseases, "aging"  
effects such as the appearance of debilitating illnesses at earlier  
ages, loss of immunity to disease, an increased risk of leukemia  
in their children. The commitment is there.

Who can be blamed for this irreparable damage? How did it  
happen? A pseudo-dichotomy clouds these questions: the culprit  
must be either nuclear weapons or nuclear plants. The convenience  
of the dichotomy for promoters of nuclear reactors is epitomized  
by the response to IAND's presentation of some of this fission  
dose evidence three years ago to the Wisconsin Radiation Protec-  
tion Council. The chairman, who is also a former vice-president  
and lobbyist for Wisconsin Electric, dismissed IAND's request for  
an investigation with the simple charge: "It's the Soviets."

The fact is that there is no clear dichotomy. Radioactive  
wastes from the Hiroshima bomb, from bomb-testing by the Soviets,  
Chinese, United States, France, from the evaporating tanks at  
Hanford, from the weapons factory at Rocky Flats, from the Uranium  
mines in Utah, from all the normal or abnormal reactor releases--  
all fission wastes lie indistinguishable by origin in our bones  
and tissues. They mingle indiscriminately in food, air, water and  
soil. The definitive evidence for a criminal trial is not available.  
The jury would need a list of all possible nuclear waste sources,  
past and present; all dates of releases, amounts released, types of  
radionuclides; wind velocity and direction; rainfall and snowfall;  
food, water, air monitoring; and much more.

Although a single culprit cannot be identified, the major  
sources of these radioactive poisons can be pointed out over a  
period of years. In the 14-year period investigated in Wisconsin  
the milk monitoring clearly shows bomb-testing fallout residual  
all over the state in 1963 with heavier concentrations in the  
north-west-central portion. Chinese weapons testing added to

the done in 1965 and 1966. In the spring of 1970 the monitoring shows a sharp rise all over the state not directly attributable to any bomb testing. No one investigated. The Dresden (Illinois) reactor to the south was releasing more radiation every year reaching over a million curies by 1970. The Genoa reactor was just beginning to operate. An "underground" bomb test in Nevada inadvertently leaked. These are all "possible" sources.

By the late 1960's and early 1970's the monitoring shows Sr-90 levels greatly diminished. From earlier contamination well above national averages, concentrations declined to the national average. Differences between northern and southern Sr-90 levels narrowed indicating that high soil deposits from bomb-testing COULD BE OVERCOME WITH TIME and that new fallout was small. In fact, in 1971 and 1972 the state monitoring shows all stations below the national average for Sr-90. The reliability of the figures is, however, questionable since no tests were taken in many months--in 1972 no Sr-90 data was collected at most stations from April through September.

This hopeful declining trend in radioactive contamination of the state changed abruptly in the later years. In the 1970 to 1976 period 12 nuclear reactors in addition to the two existing ones began operating in Wisconsin or adjoining states. Suddenly, in 1973, Sr-90 levels shot up above the national average at all six stations and stayed above the average through 1976 (the latest data available and the close of the investigated period). Contamination levels were back up to concentrations which hadn't occurred for five or six years. Meanwhile, the national average continued to decline slowly. The state average for the four-year period is more than twice the national average for Sr-90--263% higher in 1974.

Nuclear waste was raining and snowing down on Wisconsin again. Where did it come from? A check of all high Iodine-131 levels, indicating fresh fallout from recent releases, did not bear out a correlation with immediate fallout from Chinese bomb tests during this period to any significant extent. The highest levels of I-131, those above 10 picocuries per liter, do not correlate with bomb tests.



The excess Sr-90 in 1973-1976 was not evenly distributed. The Eau Claire and Green Bay stations showed the largest increase over the base year of 1971. In 1974 the Monticello (Minn.) reactor west of Eau Claire, had the highest gaseous releases from reactors in the nation; in 1974 the Point Beach plant, near Green Bay, exceeded expected gaseous releases by a factor of two according to the EPA. On the other hand, the station which showed most improvement in milk contamination relative to other stations in the second half of the 14-year period was the central Wisconsin station, geographically furthest removed from the encircled reactors. But, even at this station, contamination was above the national average--evidence that nuclear wastes do not respect the diagrammed "impact zone" boundaries delineated by the NRC for reactors.

The LAND/LEAF research team did not have the data to identify any one criminal for this recent recontamination of the state but it is obvious that the excess radiation dose over the national average is not due to residual bomb-testing fallout. It is possible that some originated at distant, up-wind nuclear weapons facilities or was delayed fallout from Chinese testing. The inconsistent distribution of the Sr-90 suggests more localized sources. For instance contamination in the Genoa reactor area diminishes in 1974 while the other stations (particularly Eau Claire and Green Bay) show increased radiation levels. On the other hand, in 1975 Sr-90 levels increased in the Genoa area while all other stations showed less contamination.

There is no one criminal. And all the criminals may well escape punishment for lack of proof of culpability. Nonetheless, they are all responsible, in whatever degree, for the accumulated nuclear waste dose to these people and the predictable increased health risks. The radionuclides which constitute this "dose" are all nuclear wastes and their accumulated effects are, as the EPA puts it, "irreversible."

The increased risk estimates, derived from actual radiation monitoring base by the LAND/LEAF research team, are necessarily conservative and incomplete. At much higher risk will be 18 to 28-year-olds, growing up in northwestern Wisconsin during the atomic era, eating generous amounts of Wisconsin cheese, venison,

pork, potatoes, fresh garden vegetables and fruits, whole grains, wild strawberries, cranberries, soy beans--exposed also to barnyard runoff, medical X-rays, natural uranium. Workers in nuclear plants will have these "population" doses in addition to accumulated "occupational" doses. Recent studies by Dr. Irwin Cross indicate that children with a history of such illnesses as allergies or asthma have 5 to 50 times the normal risk of radiation-induced cancers and that children of exposed parents are born with higher-than-normal risk of leukemia.

Will this record of cancer-vulnerability of Wisconsin's young adults and their offspring, as a result of nuclear waste stored in their body cells, give pause to those planning to generate more of those wastes in the state? Will the decision-makers think twice about jeopardizing the livelihood of the potatoe farmer, cranberry producer, dairyman, tourist and sports businessman?

Are our leaders, or even nuclear proponents, misled themselves by the mysterious "dose" numbers generated by our scientists? And do the scientists outside the inner circle of "dose estimate experts" really understand how the numbers are generated or do they just trust the "experts" as the rest of the uninformed public does?

Jacques Cousteau thinks its a plot, "the plot that science and technology are too complicated to be explained to the people.... Scientists use the same method that lawyers use when they draft a contract to make it so incomprehensible that it is worth a lot of money. And the scientists and lawyers are doing this to exploit the fact that the public accepts being considered stupid and illiterate."

The public cannot be blamed for not understanding the mysterious methodology which transforms nuclear waste into harmless low-level radiation. But Cousteau believes that "our leaders" do know: "They know that nuclear power may result in the contamination of the environment for hundreds of thousands of years. They know it will increase the rate of cancer. They know..." much more.

But even the most expert dose quantifier does not know the WHOLE truth about nuclear waste. Time and again the LAND/LEAF research team ran into blind alleys where the only "expert" opinion was "more research is needed." But will the needed research be done? Scientists who discover new evidence of hazards are likely to lose

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their grants. Their startling discoveries are viewed with the same protective skepticism with which a 19th century English clergyman's wife is said to have responded to Darwin's shocking Origin of the Species: "I hope it is not true, but if it is true, I hope it doesn't become generally known." The EPA radiation monitoring program has been cut and in Wisconsin plans are to cut monitoring frequency.

In April 1978 the NRC eliminated all mention of Sr-90 in reports of radioactive releases by power plant licensees despite the fact that utilities have in the past reported Sr-90 releases-- thus effectively eliminating this important radionuclide from future reactor radiation dose estimates. In Wisconsin the NRC has already approved a new reactor in the area with the highest accumulated radiation dose, the northwest. When LAMD pointed out the high levels of bomb fallout and the operating reactors upwind of the proposed Tyrone plant, the NRC responded that "the radioactivity remaining from bomb-testing is quite small"--that existing plants upwind will contribute "extremely small undetectable increases." They were not interested in the 14-year monitoring record at the state capitol but announced a "pre-operational monitoring program" of their own. Unbelievably, in the same document, the NRC states: "The pre-operational monitoring program is not meant to determine the radiation doses to actual individuals or populations, nor is it meant to establish input data for the site suitability decisions." In other words, the decisions have already been made before the evidence is in and the evidence already on hand has been deliberately ignored.

The state Radiation Protection Section is no more willing to research the whole truth. Three years ago LAMD asked for an investigation of why the northwestern rural counties (with the highest accumulated radiation levels) had cancer rates much higher than the southeastern urban areas. The request was ignored--the cancer rate differences are still there. The agency proclaimed one precise annual radiation dose estimate (for the LaCrosse) area which is a classical parts-missing specimen: based on one radionuclide, in one food source, for ingestion during that one year only, for an average-age population. That dose estimate is 200 times lower


than the LAND/LEAF dose findings for just three radionuclides in just food to 7 to 9-year-olds in that area, based on the 14-year monitoring record by the state. 

In addition to two new nuclear plants planned, the state is now threatened by prospecting for uranium. According to the EPA uranium mining and milling yield the very highest radiation doses due to the nuclear fuel cycle. This "uranium fever" is reported in northern Wisconsin. In this same region, the ELF-Seafarer-Sanguine project is planned. It will require large amounts of electrical energy (more nuclear plants?) and the DNR has concluded that it poses a health hazard to residents.

What about the rest of the country? Although the LAND/LEAF research team limited its investigation to the Wisconsin case-study, the evidence suggests that other parts of the country will have similar or even worse radiation dose accumulations. Wisconsin is not an isolated phenomenon--many areas had even higher bomb fallout--many are even more subject to weapons facility and power plant fallout. The dose numbers sold to the public will probably underestimate the actual dose from nuclear waste in most of the country.

A bite of the apple is not the whole apple and nowhere is the whole apple included in the clever "dose" numbers. Health departments file away monitoring data while utilities and federal agencies prepare predictions of "doses to the population" with computerized models of "design objective" releases. Bomb-testing fallout doses are spread so thinly and evenly that they become "undetectable." Even nuclear opponents argue whether bombs or reactors produce the most waste, unaware of the accumulations already stored in body cells.

No doubt, at some future date, the government will announce that the "nuclear waste problem" has been "solved." The industry will be back in business. State and local resolutions prohibiting "storage of nuclear waste" will be honored--a safe repository will be accepted by some cooperative state.

But the nuclear waste time bomb in our children's bones will tick away faster. 

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in the Midwest



Charles W. Huver, Gertrude A. Dixon,  
Naomi Jacobson, George I. J. Dixon.  
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"This careful study unmasks many of the half-truths propagated by nuclear proponents and demonstrates how poorly informed the public has been about the hazard of radiation."

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"We disregard nooses around our necks, so long as the hangman tightens them slowly. Plop a frog into hot water and he will immediately jump out. But if the temperature is raised gradually, he will sit there until he boils to death. So it is with environmental radioactivity. We are worse off than the poor frog, because we have no direct way of sensing the hot water we are in. However, dedicated works such as this one may save us in the nick of time. But time is short, and your life may depend on your taking action based on the knowledge contained herein."

L. Douglas DeNike, Ph.D.

About the authors:

Dr. Charles W. Huver, environmental biologist at the University of Minnesota, has been researching radiation pathways for many years

Radiation expert, Dr. John W. Gofman, generously contributed as Chief Consultant to the Research Team of Gertrude Dixon, M.A., Naomi Jacobson and George I. J. Dixon, Ph.D. The LEAF Research Team brings six years of intensive study of nuclear fission and work with grassroots citizen's groups to bear on their study in the firm belief that the public has a right to understand and decide nuclear issues.

AN EVALUATION OF UNCERTAINTIES  
IN RADIOECOLOGICAL MODELS

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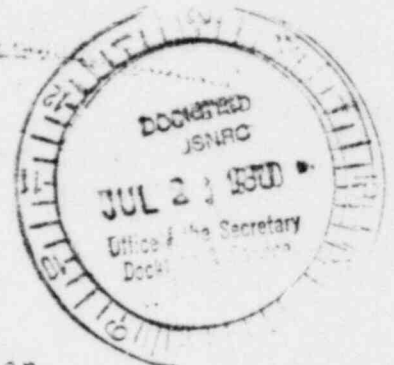
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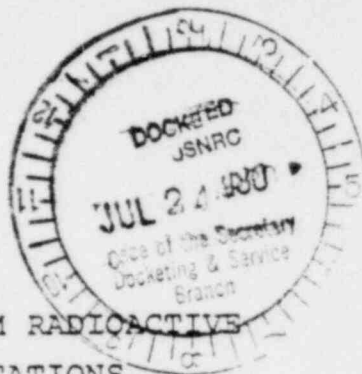
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RELATED CORRESPONDENCE

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## RELATED CORRESPONDENCE

RADIATION EXPOSURE TO THE PUBLIC FROM RADIOACTIVE  
EMISSIONS OF NUCLEAR POWER STATIONS

## Critical Analysis of the Official Regulatory Guides

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Abstract

Current regulations for radiation protection involve determining dose limits for the exposure of the individual to radioactive emissions of nuclear power stations. Supposing that a known quantity of radioactivity is emitted, exact knowledge of the parameters for the abiotic dispersion and the transfer into food-chains including the behaviour of radioactivity in the human body is very important.

Comparison of the official regulatory guides of the USA and the Federal Republic of Germany (F.R.G.) for calculating annual human doses with the results reported in the international literature shows that the recommended factors for essential radionuc-

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