DOCKET NUMBER
PROPOSED RULE PR 50
(53 FR 16435)

811 Yancey St.
Durham, NC 27701
(919)-688-3016
5.25.88

DOCKETED
USNRC

'88 MAY 27 P5:37

Samuel Chilk, Secretary
Attn: Docketing and Service, PR 53 FR 16435, no warning required at low power
US Nuclear Regulatory Commission
Washington, DC 20555

Joint Comments of Wells Eddleman and NC Citizens Research Group on Proposed Rule 10 CFR 50, no warning required at low power for nuclear plant licensing purposes, 53 FR 16435 fff, 9 May, 1988

The proposed rule is deeply flawed. Before addressing it in more detail, we believe the "Finding of No Significant Impact" (FONSI) is likely in error, and a full Environmental Impact Statement should be required. This is especially true since the proposed rule applies to licensing of all nuclear power facilities now under construction, and to all future nuclear plants, according to the Commission's own statements.

Yet, the Commission does not (and by law cannot) assume that these plants will ultimately receive operating licenses. This is particularly true of the Seabrook (NH) plant, which would still have to provide a warning system satisfying the current 10 CFR 50.47 etc. requirements to receive a full power license. (Unless the Commission later obviates <u>these</u> requirements

The case of the Shoreham nuclear plant illustrates the problems of allowing low-power operation without a full power license following: the plant that operates at low power irradiates many of its components, and its nuclear fuel, thus creating many tons of both high and low-level radioactive wastes. Widespread news accounts indicate that the cost of cleaning up the Shoreham plant will be $400 million to $500 million. If that plant had not been made radioactive, it might have a positive salvage value, instead of a negative salvage value of roughly half a billion dollars.

Moreover, NRC case law has recognized that the only benefit, for NEPA purposes, of nuclear plant operation is electricity produced. It is inconceivable that net electricity production in low power operation (below 5 percent power under NRC rules applicable to most US nuclear plants unless they receive a waiver) could equal four hundred million dollars.

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Thus low power operation clearly fails the required NEPA cost-benefit analysis. Of course, low-power operation must stand on its own for this analysis because to do otherwise would prejudge the full-power licensing process. This would be particularly wrong in the Seabrook case, since the removal of prompt notification systems that now precludes low-power licensing would still preclude full power licensing even if this ill-advised, NEPA-violating rule were adopted.

Further, the irradiated fuel after low-power operation would have to either be sold to another plant (requiring shipping in much better shielded containers than are used to transport "fresh" unirradiated nuclear fuel, and probably storage at the new site of use, where it is neither fish nor fowl, i.e. if stored directly as fresh fuel, it will be irradiating the other fresh fuel in storage; if stored as spent fuel, it will be much more enriched in U-235 and thus will be a criticality hazard) at best, or in the alternative, kept as nuclear waste and ultimately disposed of. This disposal will again be complicated by the higher percentage of U-235 in the enriched fuel irradiated by low-power operation; even natural uranium has been known to initiate a chain reaction by leaching, as at Oklo (Africa) and it is assumed than spent fuel may leak in storage at a "permanent" disposal site. Partial irradiation of fuel during low power testing can thus be a significant environmental impact, unaccompanied by any net benefits (the net benefits will be discussed more fully below).

In addition, the irradiation of the reactor internals, vessel, and associated systems of the plant during testing at low power create the need for cleanup when the plant does not receive a full power operating license or for other reasons (e.g. takeover, as proposed at Shoreham) does not operate beyond low power. This, in effect, is creating a radioactive waste site at the nuclear power plant, unaccompanied by any benefits. Operating the plant systems needed to contain this radioactivity (during either storage or cleanup) requires energy and involves some radiation exposure to personnel; cleanup involves radiation exposure to personnel and also increases the load of radioactive waste for disposal. To the extent the irradiated plant components, activated plant components or materials, etc., are disposed of as low-level radioactive waste in landfills or other undreground storage (especially where there is significant rainfall, e.g. over 25 inches per year), leakage into the environment is quite possible. All of these deterimental environmental impacts are unaccompanied by any net benefits. This is another powerful set of reasons why low-power operation where full-power operation is not assured, cannot pass the NEPA cost-benefit tests that the law requires.

More on net benefits: Assume (generously to the benefits for the sake of argument here) that the plant involved is 1300 MW (Shoreham is over 800 and Seabrook about 1150), that the plant always produces electricity when the reactor is critical (not so, especially in low power testing), that the reactor system's heat rate (conversion of heat from the reqctor into electricity) is the same at 5% power as at full power (not so: efficiency is less at 5% power) and that low power operation continues for 2000 hours at 5% power (nuclear plants in the USA often complete low power testing below 5% power in less time than this). Under these optimistic assumptions of benefits, the plant would produce 1300 MW x 5% x 2000 hours, or 130,000 megawatt-hours of electricity. Assume further that the average cleanup cost if full power operation does not occur (NRC cannot lawfully prejudge that it will) is $225 million (half the $400-to$500 million cost estimated for the 800-plus MW shoreham reactor). The cost of power is then ($225,000,000 / 130,000) per megawatt-hour, or about $1730 per megawatt-hour. This is $1.73 per kilowatt-hour, excluding the cost of nuclear fuel, operations, and maintenance. And this is a very optimistic cost estimate.

$1.73/MWH is roughly ten times the cost of oil-fired peaking power, thirty to forty times the cost of coal-fired peaking power, and over 50 times the cost of peaking power purchased in a 1000-MW block by Duke Power Co during tight supply conditions throughout the Southeast, at the hour of summer peak in 1986. Canadian hydropower, not to mention energy efficiency impprovements, comes in at costs vastly lower than $1.73 a kilowatt-hour. $1.73 a kilowatt-hour is also about 20 or more times what Public Service of New Hampshire pays for power purchased for use, from co-generators and small power producers.

For another example, combustion turbines (CTs or ICs) can be bought for approximately $270-$400 per kW or capacity. Thus, a 65 MW turbine (65 MW is 5% of the 1300 MW nuclear plant assumed in the previous paragraph: this turbine thus has the same electricity output as the assumed nuclear plant operating at 5% power, i.e. 65 MW) would cost about $26 million or less. Allowing $15 million (very generous) for other costs of installing this turbine, and fueling it with oil at a cost of 10¢/kWh ($30/bbl oil with an inefficient 20,000 BTU/kWh turbine: both of these assumptions raise the cost) and a futher generseu 10¢/kWh for maintenance and operation of the turbine generating system, there would be a running cost of 20¢/kWh and 2000 hours of operation of the turbine would cost $26 million. Adding the complete costs of buying and installing the turbine raises this to about $67 million, less than one third the cost of cleaning up the assumed nuclear plant that in low power operation would also run 2000 hours at 65 megawatts net output.

Since actual energy-efficiency measures can have net costs from 2 cents a kilowatt-hour to approximately zero (or lower: see Rocky Mtn. Institute Publication, Advanced Electricity-Saving Technologies and the South Texas Project, available from Rocky Mtn. Institute, 1739 Snowmass Creek Rd., Snowmass CO 81654, (303) 927-3851, cost curve summarized on p.32 thereof), and other generating sources noted above, e.g. purchased power on peak at 30 mills/kWh in 1000 MW block (Testimony of W.S. Lee, Chief Executive Officer, Duke Power Co., NC Utilities Commission Docket E-7 sub 408 (1986) see Transcript vol.8), peaking coal at 4-5¢/kWh running cost, or even building and running a high cost oilfired combustion turbine, all cost much less than running a nuclear plant at low power, there are clearly NO net benefits in monetary terms from low-power nuclear plant operation under NEPA. Instead, there are large net costs, both in dollars and to the environment, from cleaning up the irradiated plant and dealing with its partly irradiated fuel (which has also the potentialy of causing criticality accidents, being both irradiated, and thus harder to handle safely, and still highly enriched in U-235 compared to fully spent fuel).

Since the rule ostensibly (and in law) will apply to all future nuclear units if adopted, the need for an EIS is that much stronger. There are about 15 nuclear plants still under construction in the USA (15 units, total), and not all of these can reasonably be expected to ever operate at full power. There could be other nuclear plants licensed for construction, to which this rule would apply. Thus the total environmental impact of adopting the rule, even if no accident occur in low power operation at any nuclear plants in the future, can reasonably be expected to include the decommissioning costs of one or more irradiated plants that did not operate at full power, but only at test power levels. If test power levels above 5% are allowed, the decommissioning may be more costly. Thus an EIS is required for the fule as proposed.

OTHER DEFECTS OF THE RULE PROPOSED:

The proposal assumes that a serious accident cannot happen at low power. This is not true. First, the possibility of sabotage or terrerism must be considered. NRC rules have assumed that terrorists can have insider assistance. Incidents of accidental criticalities (e.g. NRC information notice 88-21, May 1988, citing pst incidents at Millstone (CT) and Vermont Yankee, not to mention Fermi 2's criticality during low power testing and (based on Eddleman's recollection) exceeding allowed power levels, show that even without sabotage or terrorism, accidents beyond these contemplated at low power would be possible. NRC must carefully consider the disastrous impact any accident without an effective warning system would have on NRC's public credibility, and ability to soundly regulate nuclear plants, should such an accident occur. (More on this possibility below). The possibility of more severe accidents, including those caused or made worse by operator error, improper construction, improper design, quality assurance failure, equipment failure, or other causes including possible sabotage or terrorism or both, needs to be a part of that careful consideration. NRC gives no evidence of having made any such consideration.

At low power, most safety systems are essentially or even totally untested. Leaks, pipe or weld breaks, and numerous equipment failures often occur in low power testing of nuclear plants. NRC cannot assume that safety systems will work (or be properly actuated) during low power testing. Unqualified equipment, falsified test results on equipment said to be qualified, and equipment failures and errors continue to be regularly reported, e.g. in NRC's Analysis (/Evaluation) of Operational Data office's reports. It is not prudent either to assume that operators will take the correct action should an accident occur at low power. Unanticipated accidents, the assumption that nothing serious can happen at low power, the assumption that there will be lots of time in the even of an accident at low power, and other possibilities cast doubt on this assumption.

There is no evidence that I can see that NRC has reviewed the experience of plants in low power testing (none seems to be explicitly referenced in the Federal Register proposing the rule).

Since equipment and other failures may well be encountered only for the first time in testing, and there is no assurance that safety systems will work, nor that operators will act correctly (or not exacerbate an accident), and no guarantee that power will actually be limited to 5% (see e.g. reports of accidental criticalities, improper rod withdrawal, etc), NRC cannot assume as it does, that accidents of severity sufficient to require prompt offsite alerting cannot happen once low power operation is allowed. Only when fuel has not yet been loaded could this assumption be made (and even then, allowances for possible sabotage or terrorism should be made).

NRC also ignores the very real likelihood that panic would result if an accident occurred at a plant allowed to operate at low power under this proposed rule, during "low power" operation. NRC typically assumes that panic is unlikely, although the evident from Three Mile Island is that fear did motivate large numbers of people to self-evacuate. At Seabrook in particular, NRC's actions, including this proposed rule and the rulemaking to eliminate state and local approval of emergency plans, have lowered NRC's credibility and made it less likely in any accident situation that people will trust NRC information or other official information gotten from or through NRC. This increases the likelihood of panic. NRC appears to say that the beaches near Seabrook need not be evacuated safely during an accident. Consider what might occur this summer if low-power testing at Seabrook were authorized and 100,000 people were on the beaches nearby (a number that is often attained, I understand). Many no doubt would seek to evacuate to the south, where the lack of early notification would mean that roads were more likely to be clogged by local people in Massachusetts self-evacuating.

NRC has also failed to address fully the problems with existing and planned siren notification systems at nuclear plants still under construction. the Shearon Harris licensing board wrote the NRC in 1986 concerning this issue: people may not be able to hear the sirens under certain normal conditions, e.g. being inside behind closed storm windows and regular windows

The sorts of problems the Harris board outlined need to be fully addressed. Instead, NRC is moving in the opposite direction by requiring no notification at low power that can be promptly received by the populace. Since the NRC recognized in its 1982 consideration of this issue that offsite elements including the means to provide early notification and clear instructions to the populace (effective sirens or alternatives such as dedicated phone-dialing systems or constantly-operating weather radios are needed to alert the populace to receive the information), NRC must show some change since 1982 to justify this proposed change. This they fail to do. Low power operations are no safer now than in 1982, as far as established studies go (NRC has not evidently studied this matter and relies on old staff estimates of low-power operation risks).

NRC has not provided a factual basis for reversing its earlier position. The inference is inescapable from the Commission's discussion of Seabrook and the facts, that the Commission is really using this rulemaking in a desperate effort to get Seabrook operating at low power (possibly before a new President is elected who might change policy in this area of nuclear licensing, e.g. if a single-administrator statute for the NRC passes, a new president could name that administrator and thus control and change the policy NRC now evidently pursues, of licensing plants as fast as it can.)

However, as noted above, operation of Seabrook or any other nuclear plant at low power alone, does nothing but contaminate the plant and perhaps produce varying amounts of very expensive electricity which could be produced or saved by other far less expensive means.

The issues left unresolved at low power, e.g. prompt notification of the populace in an effective manner, must still be resolved to have full power operation, so NRC's proposal is the worst of all possible worlds, incurring the negative cost and environmental impacts of contaminating the nuclear plant and irradiating its fuel, with no benefits on net, without resolving any of the outstanding problems which prevent the plant from going to full power. NRC's rule proposes no means to resolve these problems (unless the NRC intends to ignore them as it evidently has chosen to ignore the requirement for an accurate environmental impact statement on the proposed rule), so the result is that instead of having a non-contaminated nuclear plant of untested safety for operation and known inadequacies in its system for prompt notification of the public, you instead have a contaminated nuclear plant with irradiated fuel, of somewhat better known safety (knowledge acquired at the risk of accident), a target for possible saboteurs or terrorists, able to have a more severe accident especially if power restrictions or safety requirements are violated, which still does not have an adequate system in place to notify the public promptly in the event of an accident, and which will cost hundreds of millons of dollars to clean up, and which still has no known way to solve its problems which have thus far prevented full power operation. (In Seabrook's case, environmental qualification of equipment and other issues including the adequacy of the emergency plan are still in question and/or in litigation) Whether Seabrook is NRC's paradigm example for this rule, or its secret motive for proposing the rule, it is an example in fact of why this rule should not be adopted.

Wells Eddleman

Wells Eddleman
pro se,

and on behalf of NC Citizens Research Group as its Staff Scientist

25 May 1988

P.S. The enclosed article by Dr. John Gofman shows up another of NRC's errors: assuming lower-than-realistic health damage from nuclear accidents + wastes. It and its references are incorporated in these comments by reference as if fully set out here. Wells Eddleman 5/25

"REVIVAL MOVEMENT" IN RADIATION-LAND

by

John W. Gofman, M.D., Ph.D., April 1988

Part of the radiation community has recently been reviving a notion which it used to concede was irresponsble. The notion it is promoting today is that you can be irradiated at low doses and not be harmed at all.

Revival of the "safe dose" idea has direct implications for the hundreds of millions of individuals who receive low-dose exposure to ionizing radiation from medical exams (the new push for repeated mammograms is an example), from occupational situations (like the atomic veterans, and like millions of military and civilian workers today), and from the environment (fallout from Chernobyl reaches at least 500 million people).

The technical name for this notion is "protection by a safe threshold-dose." This paper will show scientific evidence, including the very newest, that no harmless threshold-dose exists with respect to causing extra cancer in humans.

1. WHO IS THE RADIATION COMMUNITY ?

By the term "radiation community," I mean everyone who needs to expose other people to low doses of ionizing radiation: the entire medical and dental profession (and most emphatically, the radiology and nuclear medicine specialties), the nuclear electric utilities, the uranium business and its owners, the U.S. Government (which sponsors both civilian and military uses of nuclear energy), and all the scientists, regulators, and dose-monitors whose livelihoods, grants, or advancements depend on the good opinion of those who need to expose other people to low doses of radiation.

Both logic and observation confirm that people who need to expose other people to radiation have a bias in favor of experts who will say such exposures create a negligible amount of radiation-induced human cancer, or better still, none at all.

It is inherently unsafe, in terms of health, to let such people sponsor (and thereby control) nearly all the research on radiation-induction of human cancer. It's as if the Tobacco Institute controlled all the research on the potential health hazards of smoking.

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"First, we have to convince the people that good health isn't everything."

With permission from Sidney Harris.

The U.S. Government has always been overwhelmingly the source of funds for research on radiogenic cancer, and it even controls much of the important raw data (for instance, the exposure-records of workers at all the national laboratories and of soldiers and naval personnel). However, governmental research funds are distributed into channels where the conflict-of-interest is not instantly obvious to the casual press. The Departments of Energy and Defense and the National Laboratories are less prominent than they used to be.

Nowadays, many grants are placed with the National Academy of Sciences (for the A-bomb survivor study and the BEIR Committee reports, for instance), the National Cancer Institute (whose former director, Arthur Upton, came from the Oak Ridge National Laboratory), the Environmental Protection Agency, medical research centers, and with countless professors of "environmental sciences", "biostatistics", "physics", and "biology."

These research funds have necessarily created a huge pool of sponsor-friendly radiation experts. Some are available for service with the radiation committees, service as expert witnesses for defendants in radiation lawsuits, service running and advising the professional journals, and for public education via mass media.

2. EXAMPLES OF THE "REVIVAL MOVEMENT"

- Sept. 27 1988: Bertram Wolfe, President (then) of the American Nuclear Society: "There is an increased risk of future cancer for doses of 100 Rem and above...At much lower, more common radiation exposures, no clear effects on health have been found despite more than 40 years of looking." (Article by Wolfe in the DENVER POST, page 4B.)

- Oct. 27, 1988: Dr. Dixy Lee Ray, former chairperson of the Atomic Energy Commission, charges myself and 'anti-nuclear activists' with disregarding "the extensive and growing evidence that even chronic exposure to low levels of radiation causes no damage." (Article by Ray in the WASHINGTON TIMES, Section M.)

• August 7, 1987: In the JOURNAL OF THE AMERICAN MEDICAL ASSN, an invited 'commentary' article entitled "Physicians' Obligations in Radiation Issues" was written by Merle K. Loken, M.D., Ph.D., from the Div. of Nuclear Medicine of the University of Minnesota Hospitals. Loken tells his huge readership (the emphasis is his own) that "Effects, whether genetic or somatic, have been clearly demonstrated ONLY after exposures to relatively large doses of radiation (usually more than 100 rads)...In the final analysis, NO DATA FROM HUMANS EXIST THAT SHOW THAT LOW-LEVEL RADIATION EXPOSURES PRODUCE MEASURABLE BIOLOGIC EFFECTS."

• Fall 1987: U.S. Dept. of Energy report HEALTH AND ENVIRONMENTAL CONSEQUENCES OF THE CHERNOBYL NUCLEAR POWER PLANT ACCIDENT (DOE/ER -0332) put this footnote on its tables of estimated cancers from the fallout: "The possibility of zero health effects cannot be excluded."

• Feb. 1988: Robert E. Alexander, U.S. Nuclear Regulatory Commission, Office of Research, and President of the Health Physics Society, writes about potential cancer and genetic consequences of nuclear power accidents, and urges readers not to eliminate "consideration of the probability of zero effects, a highly significant probability at low doses." (ENVIRONMENTAL SCIENCE AND TECHNOLOGY, Vol.22: 2: p.144.)

• April 4, 1988: Arthur I. Holleb, M.D., Senior V.P. for Medical Affairs for the American Cancer Society, advocated repeated mammograms for women during his appearance on Cable News Network (Sonya Friedman program). Discussing the risk of the exam itself causing breast cancer, he said, "Radiation exposure has been reduced tremendously since the 1960s and the risk --- if it exists at all --- is negligible."

Numerous additional examples are collected elsewhere (Go88).

3. EVIDENCE: LOW-DOSE CANCER-EFFECTS

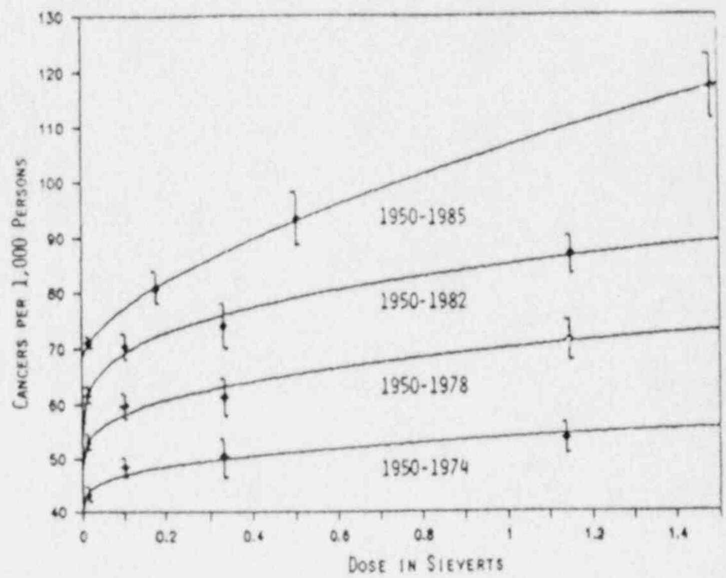
Powerful scientific evidence against any safe "threshold-dose" of ionizing radiation lies in the shape of the dose-response relationship for radiogenic human cancer.

In Figure W are the dose-response curves which the radiation community has surely hoped never to see.

Those four curves condense a mountain of human evidence as it has unfolded over the years in the 1950-1974, 1950-1978, and 1950-1982 follow-ups of the A-bomb survivors, as well as for 1950-1985 in the new DS86 database ("the new dosimetry") whose scientific status is so problematic.

The curves plot the cancer-rate per 1000 persons versus internal organ-dose in sieverts (1 sievert per 100 rems). Where a curve meets the vertical axis, the value of the intercept is the spontaneous cancer-rate during that period per 1000 persons. Of course each curve lies above the earlier curve because the longer you watch a fixed group of people, the more cases of cancer the people develop.

FIGURE W.
Cancer-Rate vs. Dose in A-Bomb Studies



Associated with each curve are four datapoints, with error-bars. These are the actual observations reported by the RERF (Be78, Ka82, Pr86, Pr87). Each curve is the best fit for its own four datapoints, by the method of curvilinear regression. Is curvilinear regression the scientifically appropriate way to handle such data? Indeed it is. Essentially no one disputes that the curvilinear regression which provides the best fit to the available data also provides the soundest idea of what the dose-response is truly likely to be.

It should be noted that Figure W involves no extrapolation. Curvilinear regression is a technique which can take account of the relative reliability of each actual observation and can tell you what curve you would be most likely to see if you had more observations, in between the ones which you do have. Curvilinear regression interpolates between datapoints and smoothes out the wobble which comes from the random fluctuations in all measurements.

What is self-evident from Figure W is that these dose-response curves have neither the shape of a straight line (the linear relationship), nor the direction of bend illustrated in Figure F (so-called "concave-upward"). All the curves in Figure W have the supra-linear shape (so-called "concave-downward").

Supra-linearity in and of itself is powerful evidence not only against any harmless threshold-dose, for the reasons explained below, but also against additional falsehoods which are promoted by some influential members of the radiation community:

■ FALSEHOOD 1: At acute (instantaneous) LOW doses, the risk per sievert of exposure is much LESS than the risk at acute HIGH doses, so people (like Gofman) who use the linear relationship to extrapolate from high doses down to low doses are exaggerating the cancer-risk at low doses. This claim often includes display of Fantasy Curves, like the "concave-upward" illustrations in Figure F ("F" for Fantasy).

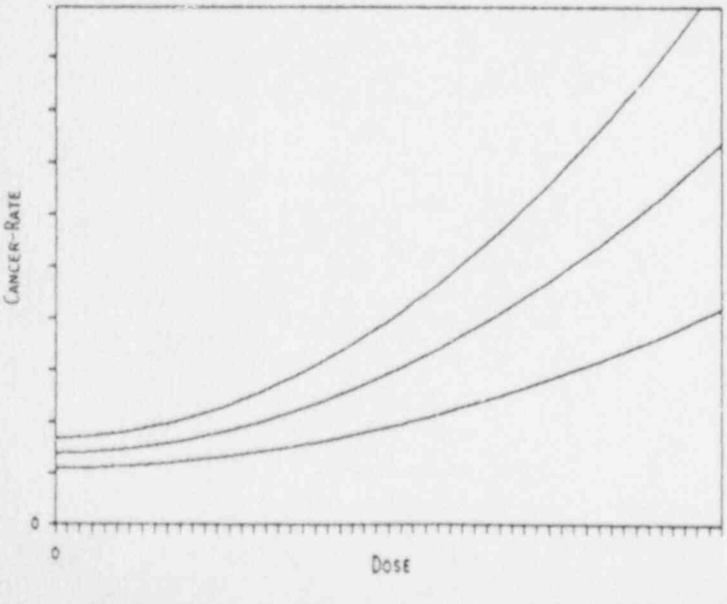
■ SCIENTIFIC REALITY: Figure W ("W" for Woe) is based on evidence rather than fantasy. It shows that the calculation of future cancers from the linear dose-response model will never over-estimate the number of radiation-induced cancers from low doses; the linear model UNDER-ESTIMATES THEM. In all the curves, the steepest rise in cancer-rate occurs closest to the vertical axis --- in other words, THE RISK PER SIEVERT IS THE MOST SEVERE AT THE LOWEST DOSES. Those who claim the opposite may also claim that black is white.

■ FALSEHOOD 2: Whenever doses are delivered slowly, they are less harmful than the same doses delivered instantaneously, so risk-estimates from the A-bomb survivors have to be reduced whenever doses are given gradually over time.

■ SCIENTIFIC REALITY: The above claim is not based on any human epidemiologic evidence whatsoever; the claim is based on speculation from Fantasy Curves like those in Figure F.

Protection from slow delivery of radiation could occur, and probably would occur, if radiation-induced cancer depended on the interaction of two or more injuries. As dose went down, injuries would be less closely packed both in time and space, and the probability of carcinogenic interaction would decrease. If this were happening, the evidence on dose-response would be concave-upward, as explained elsewhere (Go81, pp 389-401).

FIGURE F.
Curves with "Concave-Upward" Shapes



But the supra-linear shape of dose-response in Figure W tells us something very important: radiogenic cancer does not depend on the interaction of two or more events. The evidence shows that dose-response bends in just the wrong direction for "protection by slow delivery." This is most notable at the lowest doses.

■ FALSEHOOD 3: There is a significant probability of a harmless threshold-dose and ZERO radiation-induced cancer from low-dose exposure.

■ SCIENTIFIC REALITY: The available evidence, condensed in Figure W, clearly indicates that (A) the most severe cancer hazard per dose-unit occurs at the lowest doses, and (B) radiation carcinogenesis is not a "two-hit" or multi-injury phenomenon. What the curves of Figure W suggest is that radiation carcinogenesis is probably a single-hit phenomenon --- proportional to dose (linear) at very low doses, and that as dose rises, additional carcinogenic injuries in the same cell are simply redundant, and injuries which prevent cell-replication are also occurring. Under such circumstances, additional dose-units are less and less effective at producing additional cancers. Thus the steep slope at low doses turns to a more gentle rise (less effect per sievert at higher doses).

The available evidence does not contain even a hint of a concave-upward dose-response; the Fantasy Curves are fantasies. This should discredit the speculation that repair mechanisms are swamped at high doses, but that as dose decreases, repair will work better and better, until finally at some very low dose, repair will work perfectly and deliver a safe threshold-dose below which no radiation-induced cancer occurs.

Unfortunately, this is NOT what is actually happening. How do we know? If repair were working better and better as dose decreases, the dose-response curves would be concave-upward, and would be flat as they approached the vertical axis. But what the evidence shows for dose-response is exactly the opposite. In Figure W, the slope --- which depicts the change in cancer-rate per sievert --- grows steeper and steeper as the curves approach the vertical axis.

The no-threshold meaning of Figure W is independently confirmed by human epidemiology in five other studies of exposures at or nearly at the lowest conceivable dose-rate (Go88; Go88).

In view of what I see from the real-world evidence on radiogenic cancer, it would be reckless disregard for the lives of others if I were to favor revival of the harmless threshold-dose.

4. WHY DO EXPERTS DISAGREE ?

People always want to understand why experts disagree. In any field, one must distinguish between genuine scientists and some experts who may be overly sponsor-friendly. I'm not at all sure that the responsible scientists in this field do disagree. Examples:

Dr. Edward Radford, the epidemiologist who was chairman of the BEIR-3 Committee, wrote a vigorous dissent when the National Academy of Sciences issued an unprecedented "recall" of the Committee's report. After the "recall" and intervention by a special new panel appointed by the NAS, the Final Report on ionizing radiation came out in 1980 supporting a concave-upward curve for dose-response. Radford said, correctly, that the concave-upward model "has already been refuted by the evidence."

Then in 1983, scientists of the A-bomb study published an analysis showing that the evidence from Nagasaki (where neutrons were no issue) was consistent with a linear or supra-linear dose-response, but not with concave-upward (Wa83).

And now, in the very newest report of A-bomb survivors (Sh87, pp29-30), RERF scientists report the dose-response "invariably" comes out of the data looking concave-downward (supra-linear).

Meanwhile, the radiation committees are changing their tune. In the past, they have always emphasized that the shape of the dose-response curve is the key issue in assessing low-dose cancer-hazard, and they have put forth what I call their Fantasy Curves. The final BEIR-3 report stated that it "preferred" those shapes.

But no one wants to look outrageously wrong. With the human evidence from the A-bomb survivors so clearly showing the falseness of their preference, the radiation committees (BEIR 80, UNSCEAR 88) have started to advocate less emphasis on the human epidemiological evidence and more emphasis on cell-studies and animal experiments. This amounts to substituting speculation about what the human observations "ought" to be showing for what the actual observations of irradiated humans truly are showing! This is one way to stand science on its head.

One must never forget that the real-world evidence from whole human beings is always the ultimate reality-check, whether the issue is ionizing radiation, a new pharmaceutical, or a recommended surgical procedure (e.g., radical mastectomy could not pass the reality-check as a necessary treatment for small breast-tumors).

Why do experts appear to disagree about cancer from low-dose radiation?

With respect to revival of the safe threshold-dose, I think it receives support from almost none of the scientists who work directly and personally with the human epidemiological evidence. After 25 years of interaction with the radiation community, it is my opinion that the current "Revival Movement" originates among members of the radiation community who are one stage, two, three, four, five, six stages removed from the actual evidence.

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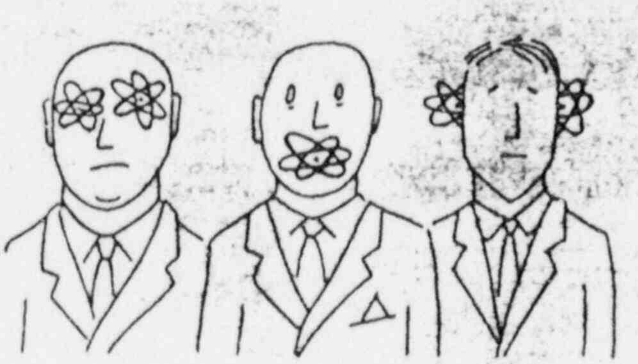

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