Letter From Kiev and Moscow: Nuclear Realities Ten Years after Chernobyl

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In the week leading to the 10th anniversary of the Chernobyl disaster [April 26, 1986] I was privileged to attend two remarkable conferences in the former Soviet Union (FSU). The Center for Russian Environmental Policy and the Natural Resources Defense Council co-sponsored an "NGO (nongovernmental organization) Preparatory Meeting in Advance of the Moscow Nuclear Safety Summit" in Moscow on April 17-18. Immediately afterward, the Heinrich Boll Foundation organized a three-day conference in Kiev entitled "Lessons of Chernobyl." I shall primarily address the latter; it is fresh in my mind, and it has left me with several concerns that I wish to share.

Kiev is a beautiful city, partly situated on a high bluff rising steeply from the (very polluted) Dnieper river. Many old churches overlook streets where life seems far gentler than in Moscow: there are fewer beggars or people selling one or two personal items and fewer obviously drunken people anesthetizing themselves from the harsh realities of their lives. This relatively calm surface covers some ugly economic realities: one of our translators was a high level physicist whose university has not paid him for the last year. If he had been paid, he might have received the equivalent of $80 a month to buy food and clothing at prices as high or higher than those in Boston (there are a few exceptions: a loaf of bread can still be bought for the equivalent of 50 cents). What neither he nor anyone else pays for are the costs of producing electricity or residential heating or energy in general.

This fact is intimately linked to all things nuclear in the FSU. Nothing about Chernobyl can be properly understood without appreciating how energy is produced, "marketed", consumed, and paid for in the FSU and the Eastern block -- and how we in the industrialized West are in the indefensible situation of admonishing our Eastern brothers and sisters to reform themselves while we pursue a course that is, in its own way, is also perverse and destructive.

The Health Effects of Chernobyl

Given what I learned, I sadly conclude that we will probably never fully understand the health effects of the Chernobyl explosion. (There are good recent summaries of current knowledge [1-4].) Arguments about the extent of the current and future burden of disease are probably futile, since the estimates on which those arguments are based are rife with uncertainties and unverifiable assumptions that are likely never to be clarified.

We are all sensitive to the enormous power that follows from the control of information, and the consequent attraction of such control. The Soviet authorities repeatedly and deliberately misled their public and the outside world, first about whether there had been an explosion at Chernobyl and, after mounting evidence made that evasion absurd, about the seriousness and extent of the catastrophe. They laid blame on the oper-

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ators who, it became clear, were close to blameless. They forbade data gathering after the explosion: Geiger counters became illegal, as did diagnoses that inferred causation by radiation. Medvedev [5] makes it clear that the underlying cause of the disaster was the Soviet system of chronic misrepresentations, secrecy, and closely held power, as well as the paucity and bias of post disaster information gathering. The catastrophe occurred during a deferred test of reactor "safety" that the authorities had falsely certified had been done before the reactor was put online (in order to fulfill their production quotas) -- a safety test that was inexplicably deferred to the middle of the night and that was forced on an incomplete and prepared crew of inexperienced operators. After the explosion, the authorities denied anything had happened until forced to admit otherwise. Precious time was lost and denial and obfuscation continued for weeks.

Epidemiology Driven by State Policy

This was not an unforeseeable "accident," but rather a nearly inevitable consequence of how the Soviet bureaucracy routinely functioned. The uncertainty was not so much whether, but when and where the disaster would occur and who its precise victims would be. There is more openness today, certainly in Belarus and the Ukraine, which now find it to their short-term advantage to maximize estimates of the damage, both to appeal to Western donors and also, in the Ukraine, to promote anti-Russian nationalism. But the remaining ambiguities in the record make estimates of the long term health consequences nearly impossible. In addition to the political distortion of medical records, radiation doses are often no better than guesswork (retrospective biologic dosimetry has cast doubt on dose estimates reconstructed from occupational and residential histories) and the number and identify of "liquidators," especially those who were recruited from the military, is a matter of conjecture.

Somehow, we believe that needed information must exist, if we could only find it. Suppose, however, that the problem is not that information, though hidden, exists; rather that there has been purposeful, systematic sabotage of the conditions that would allow information to be gathered in the first place. Research on the health of populations in the FSU typically did not meet the minimal standards that we now take for granted in places with a secure tradition in epidemiology. Work there was more than likely done without well measured and precisely defined exposures and without well established and rigorously applied diagnostic criteria. Little attention was paid to representative sampling (without which biases may remain hidden to the investigator). But why? The FSU was a technologically advanced society and the methods of good science are not that obscure. The answer seems to be that information was considered dangerous; it was far safer for the intellectually curious to play chess, or to study mathematical theory, than to investigate the health of the people. The legacy was an undeveloped science of epidemiology, one that existed to serve the needs of the state. Thus, good estimates of incidence or probable causes of illness are close to impossible to make, even without the destructive overlay of purposeful sabotage of information.

The April 19, 1996 issue of Science devoted nine pages to Chernobyl [6]. The coverage is instructive, often in unintended ways: It provides an up to date, detailed summary of much information, but also adds to the confusion and obfuscation. Science refers to the "accident" without much in the way of background to explain why a disaster such as this was the logical consequence of prior policy and actions. It repeats the canard that "much of the medical news so far is reassuring," with the exception of the hundredfold increase in childhood thyroid cancer in Belarus and Ukraine. Thyroid cancer is easy to relate to exposure to Chernobyl-generated radiation: detecting a hundredfold increase from baseline incidence is not much of a problem.

We should not be easily reassured, however, about our ability to estimate other possible health consequences. Increases in other forms of cancer, for which moderate increases in incidence must be distinguished from much higher baseline levels than for childhood thyroid cancer, may be nearly imposssible to quantify. Such increases could occur and yet be undetectable even with extensive and meticulous investigation (which is unlikely, because of inadequate resources, both financial and technical). Further, the latency period from exposure to detectable symptoms of cancer can be many decades. I am not "reassured," nor are many people in the local population who were exposed to Chernobyl's radiation. Science, reflecting its cultural identity and loyalties, treats this disaster with the attitudes and vocabulary of the scientific elite and the politically powerful.

It is absurd to have such agencies as the DOE, or Russia's Minatom, or the IAEA, whose central missions are to promote nuclear power, in the inherently contradictory role of also assessing the competitive benefits and the economic, environmental, and health effects of nuclear power (see below). Not only is there an inherent contradiction in

these missions, but these agencies' research studies and public statements, however sound, often have little or no credibility for the public. In the Ukraine the IAEA ranks only behind the former Soviet government in its lack of credibility and the conclusions of its competent, if incomplete, health studies are summarily dismissed, whether justly or not.

"Nuclear Democracy" and the Technological Elite

At the Moscow meeting, one of the most important sessions was about "nuclear democracy." This term connotes transparency of information and the rights of people to influence decisions on their nuclear future. Such democracy requires accurate, unbiased, and relevant information. The technological elite, including physicians and epidemiologists, have an unannounced and often unwitting stake in controlling both the definition of what is relevant and how information is produced and presented. It became clear that all the stakeholders, those directly exposed -- both local residents (particularly the evacuees) and liquidators -- the wider citizenry, the plant managers, the environmental community, and even the nomenklatura, need to participate in framing the research questions and deciding which ones should be pursued if the research is to be believed and to satisfy the curiosity and concerns of those involved. The technically and scientifically sophisticated should be responding with judgments on the feasibility of such requests, assessing the technical problems, the requisite intrusions into people's lives, the costs and other difficulties, and the level of uncertainty inherent in the conclusions. If the results are to be relevant, and credible, we need to negotiate with these constituencies (not to be confused with their governments), over which information gathering paths should be taken. It would be inhuman not to take cognizance of a Belorussian mother's wondering about the causes of the sickliness or death of her child, and who was to blame, and whether anything can be done to help.

It may be impossible, or nearly so, to answer such questions and the answers may turn out to be not what was expected or hoped, but it is not our business to dismiss people's concerns. Rather, health scientists need to openly -- and without condescension -- describe the barriers and the tradeoffs. We -- and the public in the FSU -- are woefully ignorant about what happened after Chernobyl and about what information can now be resurrected. Society would gain by exploring how better to define and work towards an "information democracy," in the absence of which it is hard to be optimistic about "nuclear democracy."

Nuclear Power in the Context of Overall Energy Needs

The world community wants the remaining three reactors at Chernobyl, as well as all other inherently dangerous Soviet built RBMK (high-power channel-type) reactors, shut down. Ukraine says it needs them to meet its energy needs and wants others to pay for replacing them. Siemens and Westinghouse, with the backing of the International Atomic Energy Agency (IAEA), would love to help, since they need business. There have been no new orders for nuclear plants in North America or Europe, except in France, for decades; if replacement is rejected, the companies would be almost as pleased to "upgrade" these plants and the almost-as-dangerous early Soviet VVER (pressurized water) reactors. This apparently rational approach is actually deeply flawed and dangerous -- a self-serving and short-sighted attempt to maximize both profit and the spread of nuclear power by forces that few believe are socially and environmentally beneficent. There are far better ways to meet the energy needs not only of the FSU and the East, but of the rest of the world as well.

Electrical energy is "free" to consumers in the FSU, including massive industrial plants, and there has been no incentive, therefore, to use less. In the Ukraine, the energy cost of an equivalent unit of GNP costs more than ten times what it does in the U.S. or Japan. Most industrial electricity, for example, runs motors to drive pumps. These motors in the FSU are typically old, massive, inefficient, and forced to run systems that are as wasteful and archaic as the motors themselves. Domestic electricity is not metered; domestic heating is often supplied from central plants to entire neighborhoods and there are never valves on radiators. During the Moscow conference the weather was unseasonably warm, but the heat in the meeting rooms was running full blast. The only way to cool down was to open windows!

Since the dissolution of the FSU electricity use in the Ukraine has gone down 20% because of the precipitous decline in industrial activity. Nevertheless, two of the remaining three very unsafe RBMK reactors at Chernobyl continue to be used and the third, now shut because of as yet unrepaired safety problems, is likely to be restarted. No other nuclear power reactors have been shut down in the FSU and radioactive wastes continue to pile up. President Yeltsin has approved the completion of the nuclear waste reprocessing plant in Krasnoyarsk (see [7]) that will add to Russia's massive (and as yet publicly

unquantified and undocumented) store of plutonium, increasing the chances of diversion to terrorists or to other illicit nuclear weapons manufacture. More waste will be added to the two billion Curies of liquid waste injected underground at Tomsk and Krasnoyarsk.

Security and the Economics of Energy

Persuasive speakers at both conferences offered some explanation for this dangerous state of affairs and suggested some remedies. We heard about conditions in the East, the West, and the Far East. We learned some basic economics of energy; how special interests (the nuclear establishment, including the IAEA and the manufacturers of nuclear reactors) are sources of misinformation; and how centralized bureaucratic power (both in the East and West) threaten our health and well being and that of our children. It seems fair to say that even the future of human and other life on this fragile planet are threatened. ("Gaia" -- the ecological personification of the earth's self-regulating and self-healing capacities -- never had to deal with the combined assault of entrenched economic forces the likes of Siemens, Westinghouse, the IAEA, DOE, and Minatom before this.)

If we are to have a peaceful and secure future, we must deal with the economics of energy. At the Kiev meeting Amory Lovins explained that enormous amounts of energy are being wasted and that the more this is so the cheaper it is to conserve energy (the "demand side") [8]. While standard forms of power generation might cost, say, three or four cents per kilowatt hour (Kwh) to produce (see below), cost savings from initial end-use efficiencies might cost one half to one cent a Kwh, with few or no adverse environmental consequences. Lovins is a very practical prophet: walls can be insulated, highly insulating glass can be installed, small efficient motors can replace inefficient large ones if piping systems and valves are redesigned to offer less resistance. The possibilities are nearly endless and can pay for themselves in remarkably short periods -- typically a few years. They can only pay for themselves, however, if the consumer is charged for the real costs of energy production, which happens neither in the FSU nor in other heavily nuclear-dependent countries, of which France is the prime example in the West. Moreover, these reforms will not happen if donor countries do not impart this vision, and help in the start-up of the typically small-scale enterprises that are needed. Needless to say, this is not what we are doing.

Underfunded Renewables

Bent Soerensen of Roskilde University described the state of the art in electricity generation from renewable sources [9]. Photovoltaic cells are still uneconomic except in unusual special applications and they require more research and development. Yet R&D for "renewables" has been grossly underfunded, while billions of dollars have been spent on dangerous and costly nuclear power. One example: Germany's fast breeder reactor cost seven billion DM ($4.55 billion U.S.), exclusive of R&D costs, to construct; it was still too unreliable and too expensive to put online. Solar residential and water heating ("solar thermal"), however, is now working very well in all sorts of climates. Fuel cells, the combining of oxygen and hydrogen to produce energy (the reversal of the chemistry of a car battery) remains experimental, and warrants far more investment than it has so far received. "Biomass," the use of renewable agricultural products to produce energy, has important, if currently limited, uses. Straw and wood can be burned, alcohols can be distilled from many different plant products, and methane can be harvested from animal manure and other agricultural products.

By far the best developed and most widely applied technology for renewable electricity generation is from windmills. The price is competitive (+/- 4 c/Kwh) and windmills can be dispersed, lowering transmission costs and reducing energy loss. There are now areas of Denmark in which 30% of total electricity is supplied by wind (the national total is 4% and rising). While the last U.S. manufacturer of windmills went bankrupt last year, the Danes now profitably supply half the world market. They are now developing offshore placement, to avoid using land and to minimize visual clutter.

Renewable sources of energy cannot replace fossil and nuclear fuel in the near future, however essential they may ultimately be. But they are an important component of any rational overall energy policy. Denmark leads the world in implementing such a policy. Professor Niels Meyer of the Technical University of Denmark described the evolution of his country's policy, which includes public subsidies for reducing consumption (for instance, $700M out of a total of $2B for residential insulation and for efficient home appliances and installation of windmills), opening of the power grid to small generators (say from windmills or cogeneration) and strict building codes [10]. Danish residential electric use has declined by 40% in the last decade.

Cogeneration is fundamental.

Whenever heat is produced (e.g., from industrial processes or for residential heating) electricity can be simultaneously generated, raising fuel efficiency from 40% or 50% to 80% or 90%. A third of Dutch national electricity is now cogenerated and Denmark and Finland are not far behind. Any fuel can be used for cogeneration: natural gas, especially in turbines developed using aircraft jet engine technology, is currently cheap and efficient, can be used in dispersed, relatively small applications -- lowering costs of electricity transmission -- and can eventually be replaced by methane produced from agricultural sources.

Reducing Energy Consumption: Some Financial Incentives

Major electric utilities -- which have tended to measure their success based on the amount of electricity they can sell -- have typically opposed cogeneration, seeing it as competition from producers not under their control. Meyer and Edward Smelloff from the Sacramento Municipal Utility District (SMUD) stressed that the utilities must be given financial incentives for lowering consumption and, therefore, production: society and the individual customer benefit if the total electricity bill, not the cost per Kwh, is the yardstick of success.

Smelloff's story was riveting. In the mid 1980s the citizens of Sacramento voted to shut SMUD's Rancho Seco nuclear reactor. The results have been astonishing. The utility must still spend some $30 million per year on capital costs, and $15 million per year to service the closed reactor. But they save $150 million a year in operating costs and, by aggressively promoting energy efficiency and cogeneration and by purchasing cheap power from the west coast power grid at times of peak demand, they have increased profits, have lowered total costs to their consumers (they are not subsidized), have invested more in environmentally friendlier technologies, and have attracted much new business to the Sacramento area. This is a working example of the benefits of abandoning nuclear power. SMUD has lowered costs, even while paying off the debt incurred in building the nuclear plant.

Nuclear Economics: The "Externalities"

In Eastern Europe, the FSU, and France (the only EU country building any new nuclear plants -- the last new plant in the U.S. was ordered over 20 years ago) consumers do not pay for the real costs of producing electricity. If they did, they would have an enormous incentive to end nuclear power now, independent of the dangers it carries from "accidents," from undigestible nuclear waste, or from vulnerability to terrorism (sabotage of a nuclear power plant by conventional explosives would be catastrophic).

But the costs of production -- especially of nuclear and coal-fired power -- in no way represent the real costs to society. The total costs include, in the economists' jargon, the "externalities" -- the aftermath on health, the environment, and on economic life in the future. The costs of "disposal" of nuclear wastes, the possible diversion of wastes to nefarious use, and the health and environmental effects of particulates, sulfur and nitrogen oxidation products, and CO2 (including the greenhouse effect) are all "externalities" of nuclear and coal-fired power. Wind power may now cost 4c/Kwh to produce, with a total cost of about 4.6c. The best estimates for nuclear and coal-fired power rise to well over 10c/Kwh, possibly up to 13c or 14c/Kwh.

Reframing the Antinuclear Message

This more subtle -- and more correct -- analysis suddenly changes our perspective. The antinuclear community has focussed on the dangers of plant failure, the buildup of noxious wastes, and the increases in fissile materials that could be diverted to make more weapons or that might be used by terrorists. These messages are true and compelling, even if the public has become numbed to them. We have available, however, a broader and more universal message. The issue is not only the relatively remote possibility of local and immediate disaster; it is rather whether we and our children can continue to pursue lives with which we are familiar very far into the future unless we face the realities of global energy production and use. Wasteful and environmentally destructive energy use will increase the likelihood of warfare over scarce resources (e.g., the Gulf War), will increase the disparities in health and well being between the poor and rich nations, and, inevitably, will increase tensions between the poor and rich within wealthier societies themselves, leaving our children with a dirtier, nastier, less abundant planet. ❧

References

1. Bulletin of the Atomic Scientists. Chernobyl -- ten years later. Bulletin of the Atomic Scientists 1986;52:22-59.
2. Damved H. Chernobyl 10 years after: The consequences. (Chernobyl papers no. 4.) Washington, DC: Greenpeace. 1996.
3. Ramberg B. Ten years after the Chernobyl

nuclear disaster: Continued risks, failed international efforts, and the need for a new approach. Los Angeles: Committee to Bridge the Gap. 1996.
4. WISE News Communique. Chernobyl special edition -- Chernobyl: ten years of disaster; possibility and necessity of phase-out of Chernobyl. Amsterdam: World Information Service on Energy. 1986;449/450.
5. Medvedev ZA. The Legacy of Chernobyl. New York: WW Norton & Co. 1990.
6. Balter M. The explosions that shook the world. Science 1996;272:352-360.
7. Rush D. A letter from Krasnoyarsk: Disarmament, conversion, and safety after the cold war. M&GS 1995:19-25.
8. Lovins A. Energy efficiency: Negawatts for Megawatts. At: Lessons of Chernobyl (conference). Kiev. April 20-22, 1996.
9. Sorensen B. Renewables. At: Lessons of Chernobyl (conference). Kiev. April 20-22, 1996.
10. Meyer NI, Benestad O, Emborg L, Selvig E. Sustainable energy scenarios for the Scandinavian countries. Renewable Energy 1993;3:127-136.