Giving Reason a Bad Name

Energy Probe's Comments in Response to the Atomic Energy Control Board's Consultative Document C-129

The Requirement to Keep All Exposures as Low as Reasonably Achievable

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November 30, 1994

AECB Consultative Document C-129 is available free of charge from
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EP-377
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Process Concerns: In the past, AECB has not issued detailed responses, comments, or Reasons for Decision in response to public comments on Consultative Documents – an omission that has received criticism from several public stakeholders, including Energy Probe. At various times in the past, AECB staff have indicated their intention to change this policy, at least in certain cases. We hereby request that these comments not vanish into the usual void, but that AECB issue, along with its final Regulatory Document, Reasons for Decision that summarize public comments and respond to them. We hereby consent to have Energy Probe's name attached to these comments in that document.

We are aware that it has been AECB's practice, in considering policy changes in the past, to meet behind closed door with "stakeholders" – usually including only AECB staff, licensees/polluters, and perhaps some members of AECB's Advisory Committees. We do not believe that polluters have any more legitimate claim to be heard on matters of pollution-control regulatory policy than potential victims of pollution – *i.e.*, the affected public -- or than anti-pollution advocates – *i.e.*, public-interest environmental, safe-energy, or anti-nuclear organizations. Accordingly, we hereby formally petition the AECB to notify Energy Probe of, and invite Energy Probe to, any such planned meetings or workshops. Should you wish to extend this invitation more broadly to public-interest groups, or the public as a whole, as we suggest, we would be glad to help.

Regulatory Organization: Is this one regulatory area or two?
We believe that this proposed policy suffers from the intermingling of two regulatory areas, each with its own set of considerations, requirements, and difficulties. The two regulatory areas are (1) occupational safety and health, and (2) pollution prevention. Combining the two has led the AECB into confusion and error, as we will document below in specific comments. In our comments, we will focus primarily on the area of pollution prevention.[1]

Fortunately, the general area of pollution prevention (*i.e.*, outside the realm of radioactive pollution), is a mature area of regulation, which has developed the regulatory sophistication and openness that are essential to effective pollution prevention regulation, whether the pollutants are radioactive or non-radioactive. In developing policies on prevention of radioactive pollution, AECB would do well to begin by modelling them on those of the regulators of non-radioactive pollution -- primarily Canada's Department of Environment and the provinces' Ministries of Environment.

The Title: *What* exactly should be kept "As Low as Reasonably Achievable"?
Since emissions of radioactive pollution into the environment are undesirable for a host of reasons, and not just for the short-term or "first-year" radiation doses they deliver to humans, AECB must require licensees to demonstrate that they are keeping *emissions of radionuclides into the environment* -- and not merely human exposures – as low as reasonably achievable. That simple change in title, and policy, will correct most of the deficiencies in this document, and also in AECB's traditional approach to "emissions

control". That change would also bring AECB's pollution prevention policies roughly in line with recommendation 15 from the latest (7th) report of the International Joint Commission (on the Great Lakes), and with the general pollution prevention policies of Canada and the Provinces.

The difference between the two approaches is simple and fundamental: exposures of humans to radioactive pollution can be decreased not only by pollution prevention, but also by a multitude of other means, *e.g.*: dilution, exclusion zones or "sacrifice" areas, and changes in lifestyles (ranging from a change in dietary patterns, to the closing of a farm or a water treatment plant, to government interdiction of food supplies). All of those other means facilitate pollution of the environment that can be expected to have deleterious effects (on non-human species and probably also on humans in other times and locations), and which most Canadians would clearly oppose.

Figure 1: The role of ALARA in the control of emissions or exposures -- why are dose *limits* so high?

We are generally supportive of AECB's intention to require, formally, that licensees limit public exposures to radiation well below AECB's dose limits – both today's dose limits and the lower proposed dose limits that are still not in force in Canada.[2] But we believe that the ALARA process is being used improperly, to cover and excuse radiation dose limits that are clearly unacceptably high, even if the proposed dose limits become law.

According to the International Commission on Radiological Protection (the ICRP, AECB's preferred international arbiter), one "person-Sievert" of radiation exposure (1 P-Sv) to a typical human population can be expected to create, in sum, a 5% probability (or risk) of one human fatal cancer – that is, the effectiveness of radiation at causing fatal cancer is 0.05 per person-Sievert. Further, both the ICRP and the so-called BEIR-5 report from the U.S. National Academy of Science agree that the model that best fits the human data shows a linear or proportional relationship between total radiation dose and fatal cancer risk.[3] We note that both organizations, ICRP and BEIR, have long histories of consistently raising their earlier estimates of radiation's dose-response while giving assurances that their "current" estimate is high enough that it won't have to be raised again; nonetheless, we will be adopting ICRP's "0.05 per person-Sievert" relationship as the final truth throughout these comments.

The fatal cancer risk associated with AECB's proposed dose limit for individual members of the public, 1 mSv/year, corresponds then to a 50-per-million risk of fatal cancer for each single year's exposure at that limit. (The risk at today's limit is 5 times higher.) If an average individual spends (say) 70 years at that average risk level, that individual will experience a corresponding fatal cancer risk of 3500 per million, or about 1 in 300. (Again, the risk at today's limit is 5 times higher.) We know of no evidence to indicate that the Canadian public consider fatal cancer risks this high to be "acceptable" or "tolerable" or "negligible". In fact, we are convinced that Canadians would not willingly accept such risks

from any kind of industrial pollution, radioactive or not.[4]

Not surprisingly, the standards for pollution prevention outside the field of radioactive pollution generally require that the cancer risk from a carcinogenic pollutant carry a much lower lifetime risk, usually below about 1 in 1,000,000 -- a full 3500 times more health-protective than AECB's *proposed* public dose limit![5] This enormous gap is clearly a lot to expect "ALARA" to bridge.[6] And furthermore, the gap between what AECB regulations *legally require* and what is actually minimally acceptable is not one that should be spanned by requirements that are informal, or subject to negotiation or argument, or pleadings on the basis of excessive costs. There is no inherent Canadian right to extract, or use, or create, or release radioactive poisons; there is, we believe, an inherent Canadian right not to be poisoned by other Canadians -- at least not above levels that we agree are truly negligible.

Parts C and E: The role of -- and some problems with -- cost-benefit analysis in pollution prevention.

Both in economic theory and in the field of ethics, it is not automatically "optimal" simply to follow the results of aggregate, society-wide cost-benefit analyses. For while doing so will arguably maximize total aggregate welfare, it will generally leave some individuals and groups unfairly disadvantaged. Economists refer to "Pareto optimality" (and ethicists refer to a libertarian ethic) to refer to a system in which those who benefit from the tradeoff to compensate those who lose, until they, too, consider themselves better off than before. In other words, it is inherently *unfair* to allow a polluter to put toxic and carcinogenic materials into (say) the water some of us drink or the air some of us breathe simply because the costs of abating that pollution (allegedly) exceeds an estimate of the value of the harm to us. The victims of that pollution cannot reasonably be expected to feel reassured that somebody else is coming out ahead in return for their health risks or those of their children. Failing to get the consent of the victims is in our view a violation of Pareto optimality, of the rights of Canadians to be protected from their neighbours' pollution, of ethical behaviour, and of "the polluter pays principle" as well.

Furthermore, while such an approach can arguably maximize total aggregate wealth or welfare *given a mix of facilities and technologies*, it produces a perverse impact on the choices among competing facilities and technologies, which will diminish aggregate welfare. Specifically, it allows potential polluters to choose dirtier technologies without paying the price of that choice.[7]

In addition, the results of cost-benefit analysis in the area of public radiation exposures through preventable pollution -- as opposed to occupational safety and health -- leads to especially absurd results, through the exclusion of any impacts of pollution other than human radiation exposures (and in practice, usually only those that occur soon and nearby). Consider an example, in which our society is faced with two alternatives: in alternative scenario A, three human beings are killed, say, by gunfire or in an in-plant

accident, or even by occupational exposure to a carcinogen (radioactive or not). In alternative scenario B, enough persistent toxic material (radioactive or not) is broadcast over the countryside to cause an estimated three human deaths. We believe it is obvious that the total "costs" of alternative scenario B, to society and to the planet, is significantly greater than the costs of alternative scenario A (tragic though it would be, of course). Not only would three humans have died (as in scenario A), but the countryside would also be polluted, subjecting non-human species to possible morbidity and mortality, and subjecting humans to morbidity, and decreasing welfare in aesthetic or psychic ways as well.[8] We would not only have lost three lives, but we would have lost a clean environment as well.

But the Consultative Document – and the "international consensus" that it relies on at the top of page 3 – chooses a value of $100,000 per person-Sievert for both occupational and public-pollution exposures – *regardless* of whether the exposure is the result of a "clean" exposure of a worker to X-rays or gamma-rays, or the result of massive contamination of a remote landscape with few human inhabitants. There may be countries where that approach accords with public values, but Canada is clearly not such a country! (This absurd equivalence may be another "cost" of the combination of two separate areas into this one document.)[9]

Part C -- The absolute cutoffs for ALARA.

It is not obvious that there is any legitimate need for the absolute cutoffs for ALARA that Part C provides.[10] The only actual regulatory effect of an absolute cutoff is to limit the flexibility of AECB to require further reductions – presumably easy and inexpensive ones – when doses are already below these absolute cutoffs. But the lower the dose, the easier (and cheaper) it is to argue against further reductions (especially in a framework where economic factors are prominently taken into account), even without absolute cutoffs, so the effect of those cutoffs is not clear. What is clear is that the proposed dose criteria for the cutoffs are far too high to fulfil their function, as discussed below.

The absolute cutoff for individual dose is too high -- comparable to present exposures that should be reduced.

In the past, AECB has used the "one percent of DEL"[11] level for nuclear generating stations -- an "action level" or "administrative control level", as discussed in Section D.2.5(b) of C-129 -- as such an absolute cutoff for concern about radioactive emissions. Since the (100%) DEL level corresponds to an individual public dose of 5 mSv,[12] AECB's historic absolute cutoff for emissions from nuclear generating stations has for decades been set at 1% of 5 mSv, or 50 μSv -- the same level as proposed in section C.(i) of the new proposed regulation! (That 50 μSv level, sustained over 70 years, corresponds to a fatal cancer risk of 175 per million.) In other words, despite the bad news about radiation from the latest ICRP and BEIR, despite the proposed reduction in the legal maximum radiation dose, despite evidence, if not proof, that the populations near Pickering and Bruce generating stations are suffering significant excesses of childhood leukemia mortality, despite public

concerns about radiation from nuclear generating stations that has prompted AECB to develop a public radiation monitor for public distribution around Pickering and Darlington stations, and despite the recent report of Ontario's Advisory Committee on Environmental Standards calling for a 2,000-fold tightening of standards for tritium in drinking water, on the basis of maximum tolerable cancer risk,[13] AECB is proposing in 1994 that doses as large as those permitted by the regulatory policies of the last 20 years be ignored without recourse -- "deemed to be as low as reasonably achievable without further evaluation". That is not an acceptable approach.[14]

Moreover, these supposedly negligible or "*de minimis*" dose levels produce results -- *i.e.*, emission levels deemed to be as low as reasonably achievable without further evaluation – that are obviously *not* as low as reasonably achievable. For example, the individual limit in Part C would produce a permissible annual emission of tritium at Point Lepreau Nuclear Generating Station that is significantly larger than the entire station's inventory of tritium -- hardly as low as reasonably achievable, such an emission is so large that it is physically *not* achievable! The results of the proposed individual dose cutoff with tritium emissions at Darlington and at the Darlington Tritium Removal Facility are almost as absurd.

If absolute limits are to be used for the ALARA exercise, the most relevant yardstick is the *total harm* that could be reduced or avoided -- yet that criterion is totally absent! In Part C, the two criteria of relevance to radioactive pollution prevention are as follows:[15]

(ii) dose to individual members of the public is unlikely to exceed 50 μSv per year, and
(iii) the annual collective dose (both occupational and public) is unlikely to exceed 1 person-Sv.[16]

Both of these criteria (and also the first, which regards occupational doses) limit the dose received *per year*, with no indication of the duration of the exposure. The argument is then made (top of page 3) that

> "a simple cost-benefit calculation based on [$100,000 per person-Sv] could not justify spending more than about $100,000 per year to reduce a collective dose of this order to zero. The cost of professional services to carry out the analysis would likely cost the majority of this sum even before any additional radiation protection measures could be implemented."

But the analysis is presumably to be done *once*, while the benefit in avoided dose would accrue every year, for *as long as the exposure persists*. For example, even if the radioactive pollution is in the form of extremely short-lived radioisotopes emitted by a nuclear generating station with a 40-year life expectancy, the abatement would reduce risks for 40 years, "justifying" an expenditure of $4 million. More realistically, the radioisotopes emitted would have half-lives ranging from around 12 years (for tritium) through around 30-years (for common radioisotopes of Strontium and Cesium), through tens of thousands of years (for several activation products and a few fission products). So, abating emissions for 40 years, or even less, will have radiation-exposure benefits for many years. Indeed, the

benefits of abating emissions of uranium, thorium, radium, and Carbon-14 -- all of which have enormously long half-lives and are emitted by both short-lived facilities and "permanent" waste-disposal schemes -- would persist for many thousands of years. Deeming such emissions to be "as low as reasonably achievable without further evaluation" simply on the basis of the *annual* exposure rate is clearly an error in cost-benefit calculation. (It also appears ethically reprehensible.)[17]

Fortunately, human ingenuity is capable of integrating those annual exposures over time to estimate (albeit crudely) the total dose commitment to the entire population over the radioactive lives of the radionuclides. That figure -- **total population dose commitment** -- is the only real indicator of the total expected human-health detriment from the emission of the radioactive pollution in question. At least where longer-lived radionuclides are concerned, that figure must be the basis for the absolute cutoff.

If Energy Probe were asked to suggest a value of total population dose commitment that might be considered low enough that it would justify an absolute cutoff of concern without further evaluation, we would suggest that it be significantly lower than the dose commitment associated with an expectation of one fatal cancer. In other words, given the heroic and expensive treatment that our society extends to treat individual cancers, it would seem inappropriate to ignore the possibility that a relatively inexpensive pollution-abatement measure could prevent a fatal one. We would suggest something in or below the range of 1 P-Sv, which would correspond to one twentieth of a fatal cancer. (Of course, higher doses might still be permitted if abating them were judged not "reasonable" under part E of this proposed regulation.) We would also insist that the risks to individuals not be expected to exceed a truly *de minimis* level of cancer risk -- *i.e.*, a lifetime fatal cancer risk of one in one million.

Even for short-lived facilities and radionuclides, the absolute cutoff may come up with perverse restrictions because of multiple facilities.

Another problem with the "simple cost-benefit calculation" above is that many facilities that create individually small doses may be numerous -- *e.g.*, medical accelerators, nuclear medicine facilities, industrial radiography units, etc. In these cases, the costs of analysis and the cost of dose-reduction (*e.g.*, by better equipment design) may be low because they are effectively spread over many facilities; conversely, the total dose and risk that can be avoided by dose-reduction activities may be quite large in aggregate. In other words, it may well be worth going well below (say) an annual collective dose of 1 person-Sv *per facility* or *per licensee* if the number of similar facilities is large.

Part D, section 1: Can AECB itself pass such a test?

In section D.1., the document correctly notes that effective action in radiation protection requires that

> senior management should . . . establish a culture within which all those in

> the organization recognize the importance of restricting exposure to ionizing radiation.

We concur completely. But we note that within AECB itself, discussions of artificial preventable radiation exposures to innocent members of the public are inevitably compared directly with unavoidable exposures to natural background radiation, or with potentially lifesaving and voluntary exposures to medical X-rays.[18] The risks of cancer are seldom quantified, and regulatory actions in pollution prevention are never compared to those of environmental regulators. These behaviour patterns may help preserve the jurisdiction of AECB and keep it safe from effective reform, but they do not indicate, in our view, a culture within which all those in the organization recognize the importance of restricting exposure to ionizing radiation.

Parts D and E: Are they about occupational health and safety, or about pollution prevention?

We find sections of Parts D and E confusing and unfocused because the authors sometimes focus on pollution prevention to the exclusion of occupational health and safety, and sometimes (more often) focus on occupational health and safety to the exclusion of pollution prevention. If, as we recommend above, the document were split into two, some sections would be similar, but all would be more clearly focused.

How are conflicts to be resolved between occupational health and safety, and pollution prevention?

The Consultative Document never mentions – and certainly never resolves – the conflicts between the two goals. For example, in Section D.2.2 ("Necessary Elements in the Approach to ALARA: Resources"), the list of necessary resources includes "ventilation" without mentioning that ventilation (especially where it is unfiltered) generally increases public dose in order to decrease occupational dose -- a challenge to ALARA. The same passage does not mention several of the most commonly used means of reducing doses to the "critical group" of the public: dilution of radioactive effluents into large volumes of clean surface waters or clean air, and protraction of large releases over hours or days.[19] We can understand AECB's reluctance to highlight these embarrassing ways of lowering individual "exposures" while maintaining large emission or pollution rates; but it is misleading to omit mechanisms that are so widely practiced and so clearly encouraged by AECB's regulatory approach.

In our submission, there is a need to prescribe explicit principles for the making of tradeoffs between occupational exposures on the one hand, and public and environmental exposures on the other. We suggest one such principle: No practices to control occupational exposures will be permitted which raise public and environmental exposures, unless Best Available Technologies are applied first. This would expressly prevent "cheap and dirty" solutions to occupational doses, like unfiltered ventilation and unfiltered pumpouts.

We recommend that AECB withdraw this document and reissue a pair of documents, one of them a proposed policy on ALARA for occupational safety and health, and the other a proposed policy on radioactive pollution prevention. We believe the mere framing of the second document in appropriate terms will help ensure that its policies are appropriate.

End-Notes

1. We assume that the representatives of radiation workers will be addressing the area of occupational safety and health, as they have in the past.

2. The proposed public dose limit attempts to produce the same risk level that the old dose limit promised, but did not deliver. The proposed limit takes account of the 5-year-old acknowledgement by the "international consensus" (the ICRP and BEIR committees) that their earlier estimates of the effectiveness of radiation at causing cancer had been too low, by roughly a factor of five.

3. The "bottom-line" dose-response estimate in the BEIR-5 report is 8% fatal cancer per person-Sv. The introduction suggests, however, that the figure could be reduced at low doses and dose rates by as much as a factor of two -- *i.e.*, to 4% fatal cancer per person-Sv.

4. In earlier documents and presentations, AECB staff have suggested that radiation risks are the "cost" society bears in return for the "benefits" of cheap, reliable electricity. In the 1990s, however, nuclear power has been acknowledged as an uncompetitive source of electricity, especially in Ontario, where Ontario Hydro Nuclear received in 1994 a $3.2 billion "transfer payment" from the rest of Ontario Hydro in order to be able to pay its bills! As a result, we have not heard much about the benefits recently, but we are starting to hear suggestions -- *e.g.*, in Part B of this Consultative Document -- that radiation protection measures might be diluted because of factors

> such as the commercial viability of a facility and its relationship to the local life-styles and economy, and indeed to the provincial and even national economy.

Somehow, we seem to be proceeding directly from a period when high risks were supposedly tolerable because the polluting industry was profitable, to a period when high risks are to be tolerated because the polluting industry is *not* profitable!

5. It is true that radiation-protection standards apply to the entire family of radioactive pollutants (as well as to penetrating radiation emitted directly by licensed facilities,

although that direct radiation is not usually an issue), while the standards for chemical carcinogens apply to *each* carcinogen, or to families of carcinogens. Theoretically, in a world with very many regulated carcinogens of both kinds, the difference could be very important. In practice, the cancer risks from real-world facilities' effluents are generally dominated by a very few substances or families of substances, radioactive or not. If they are radioactive, those effluents are allowed to cause more cancer than if they are not.

6. In the field of pollution and public health, the calculation of doses that correspond to acceptably low risk levels -- *i.e.*, lifetime risks on the order of 1 fatal cancer per million -- can never be directly proven correct, but must be calculated by extrapolation with mathematical models from higher exposures, to humans or animals or both. That is the basis of (for example) drinking water standards for carcinogenic chemicals, and it must also be the basis for comparable limits and standards for radioactive substances. It is technically true in both cases that science cannot prove beyond a reasonable doubt that such small exposures actually cause cancer; it is equally true in both cases that science cannot prove beyond reasonable doubt that those same exposures don't actually cause much more cancer than the model indicates. Indeed, if the model provides the best fit to the evidence (as the linear risk model does to the radiation-cancer data for most forms of radiation and cancer), then it is equally likely that the truth is above the model as below it.

7. In today's environment – when full-scale nuclear generating stations are starting to shut down forever, and when there is an abundance of generating capacity "waiting in the wings", much of it in the form of small-scale hydroelectricity and especially ultra-efficient combined-cycle cogeneration with natural gas – incentives and "signals" to influence the choice of electricity generating technology can obviously have a real impact on the mix of technologies and facilities in use. We note here that AECB's own Advisory Committee (ACNS) has reported that natural gas generation (even at low efficiencies, comparable to nuclear-plant efficiencies) creates lower public and total health risks than nuclear generation.

8. It is of course these values that make Canadians willing to pay to preserve wilderness they will never visit, and that makes drinkers of bottled water feel diminished when surface water pollution levels increase, and willing to pay, or to change lifestyles, to help clean up the Great Lakes (from which they do not drink).

9. It may be worth pointing out that this "international consensus" is presumably the international consensus of the radiation-protection community, which generally ignores all environmental effects except the effects on human health, and fails to protect human health up to the health-protection standards of environmental protection in advanced countries like the U.S. and Canada. We do not believe that Canada and Canadians have much to

learn from the values these foreign authorities place on human life and health or on environmental protection.

10. The absolute cutoffs are actually called "criteria for determining if doses can be deemed to be as low as reasonably achievable without further evaluation".

11. DEL stands for Derived Emission Limit. AECB and licensees also refer interchangeably to DRL, for Derived Release Limit. The action levels for uranium refineries and other licensed facilities were often set at higher levels than 1% of DEL.

12. This dose is calculated for the average member of the so-called "critical group" – the coherent sub-population that is thought to be the most exposed to radiation from the emissions.

13. The report, entitled *A Standard For Tritium*, was released on May 27, 1994, and is available free of charge from the Advisory Committee, 416-314-9265. In addition to the Committee's important findings and recommendations (still under consideration by Ontario's Minister of Environment and Energy at the time of these comments), Appendix V of the report reproduces an interesting report from the Science Advisory Board of the U.S. Environmental Protection Agency, which describes, explains historically, and wrestles with the double standard between radiation-protection and chemical-protection -- both of which in the U.S. are now the responsibility of the E.P.A..

14. Interestingly, traditional AECB and licensee practices would dictate that the "action levels" or "targets" for critical-group exposures from nuclear generating stations in Canada -- universally set at 1% of the legal dose limit, or 50 μSv -- would naturally and automatically move down to 10 μSv when the proposed public dose limit becomes law. That is, the targets (effectively the ALARA cutoff levels) would naturally have been maintained at 1% of the new dose limit -- corresponding to the risk level that we were "promised" by the old exposure levels, under the old dose-response consensus. Ironically, the proposed policy in C-129 would ensure that no such reduction in emissions takes place. As a result, public risk levels from actual and "target" emissions will be roughly five times higher than the public was assured when these plants were built and started up. (We note that AECB Board Member Document BMD 90-83, dated April 18, 1990, proposed that "effluent targets . . . should not be based on a percentage of regulatory limits." Although the percentages are quite inconsistent between types of facilities, this BMD was apparently never adopted as AECB policy.)

15. The other criterion -- (i) individual occupational doses are unlikely to exceed 1 mSv per year -- concerns workers inside the plant.

16. This third and last criterion actually ends with a nonsensical comma, which we assume is a typographical error.

17. We understand that AECB's Advisory Committee on Radiological Protection (ACRP) is currently working on a policy for long-lived radionuclides. We also note that the ACRP's published document on the application of ALARA noted the importance of estimating the impacts of emissions of such radionuclides over relatively long periods (absent from this document) and over very long distances (not clearly required by this document).

18. In all fairness, we are pleased to acknowledge that this Consultative Document itself seems never to justify radiation exposures by comparison to either natural background radiation or medical exposures. On the other hand, the arbitrary choice of the actual cutoff levels in Part C -- levels we believe are far too high -- is never adequately explained, and may well represent a "hangover" from AECB's historical confusion between the public doses which it regulates and those which it does not regulate. Indeed, the suggestion on page 3 that cutoff (iii) flows from the radiation-protection community's "international consensus" supports this view, since ICRP and the UN's similar Committee (UNSCEAR) have frequently engaged in that confusion.

19. At a typical Ontario Hydro nuclear generating station, roughly one million gallons of Great Lakes water is pumped through the station each minute in order to create a vacuum at the low-pressure end of the turbines. Most of the stations' radioactive effluent pipes are routed into this "condenser cooling water" stream. This practice does nothing to prevent emissions or pollution (indeed, give AECB's regulatory approach, it enables large increases in permissible pollution), but it does lower "exposures" -- especially to *individual* members of the public. Similarly, the tall stacks found at all nuclear generating stations are there to dilute large quantities of radioactive effluents into even larger volumes of fresh air.